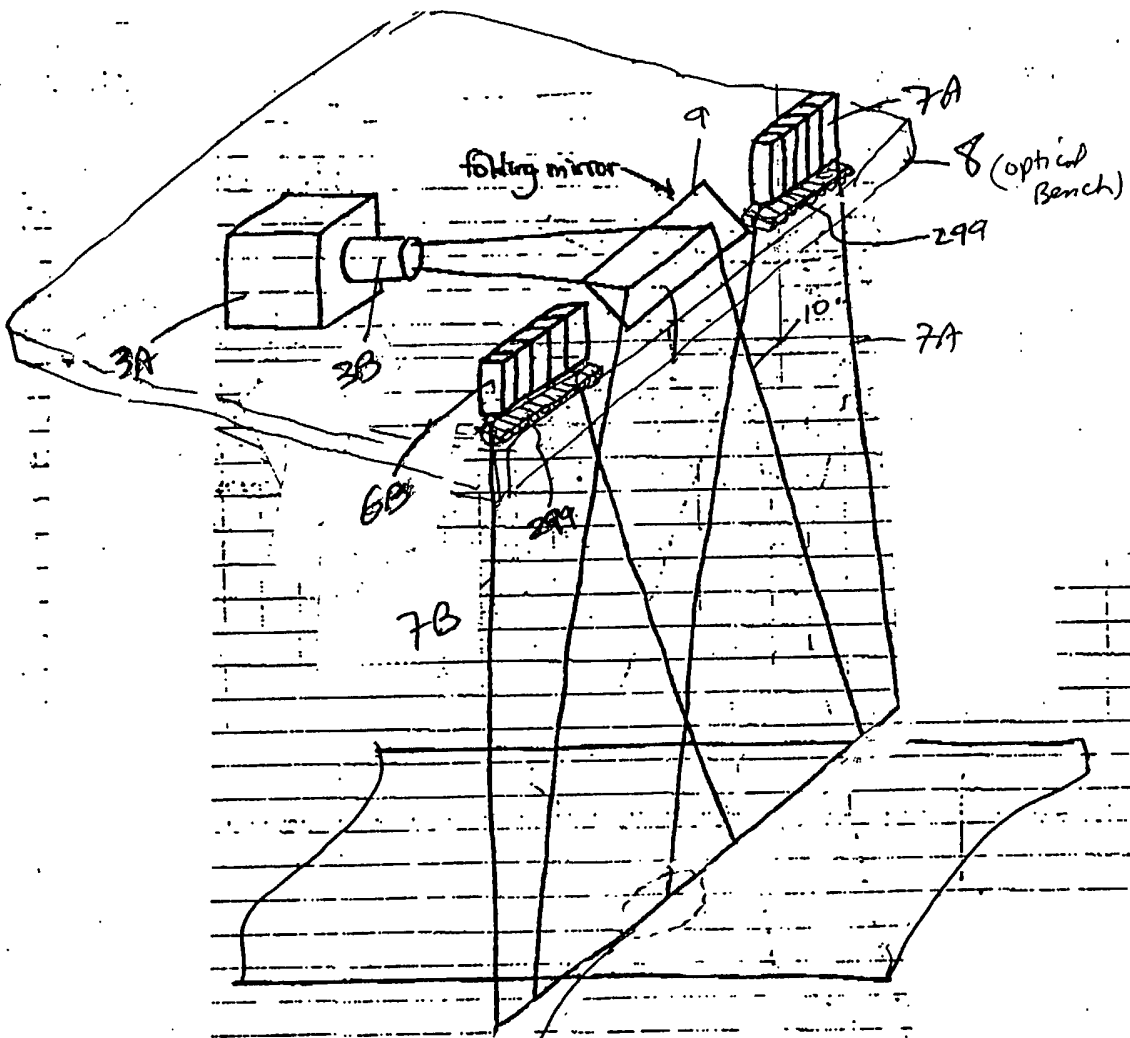


FIG 1A

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1A

FIG 1B1

Magnified Field of View of  
CCD sensor element on  
object  
width of projected  
laser illumination  
beam on  
object

FIG 1B3

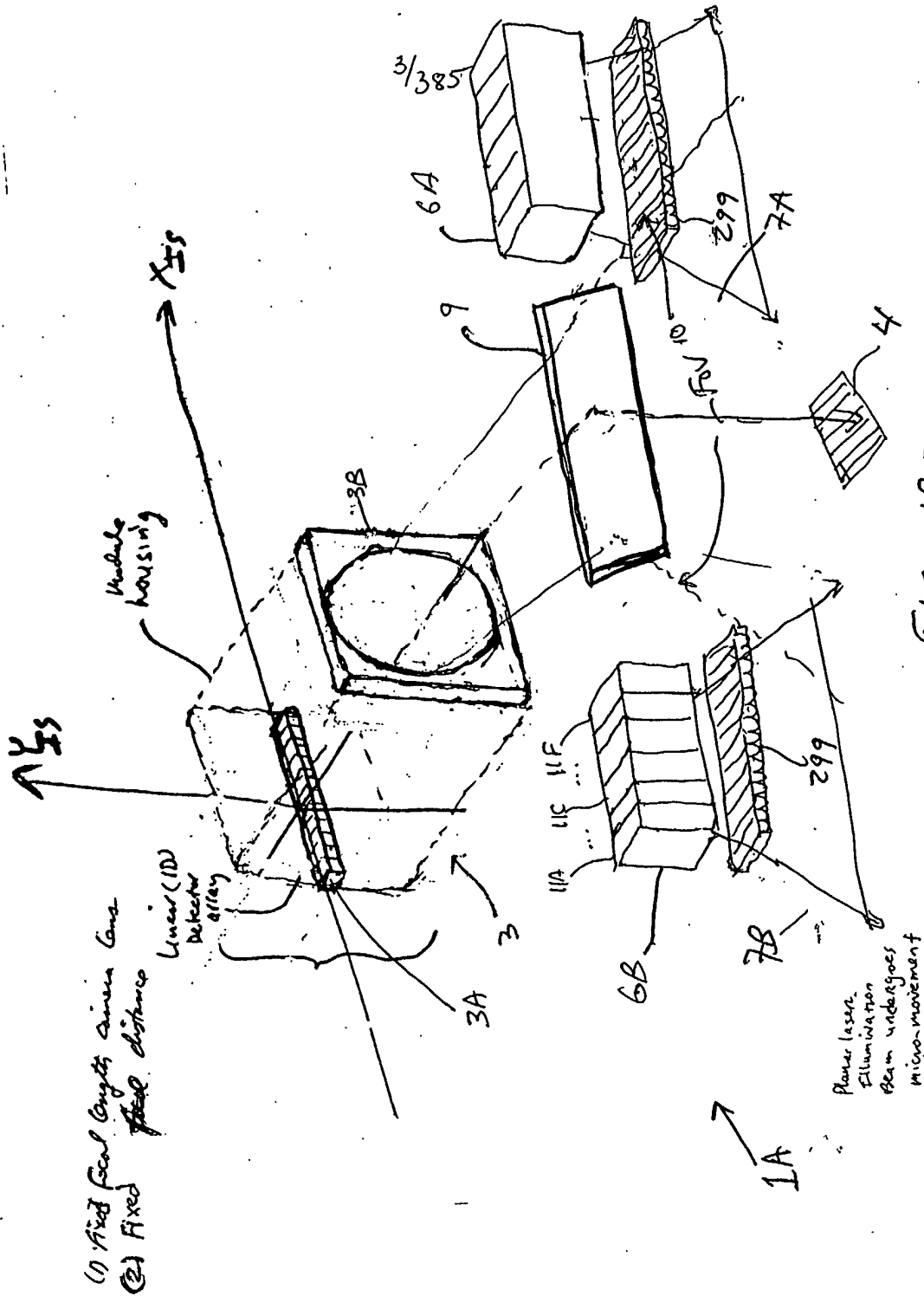
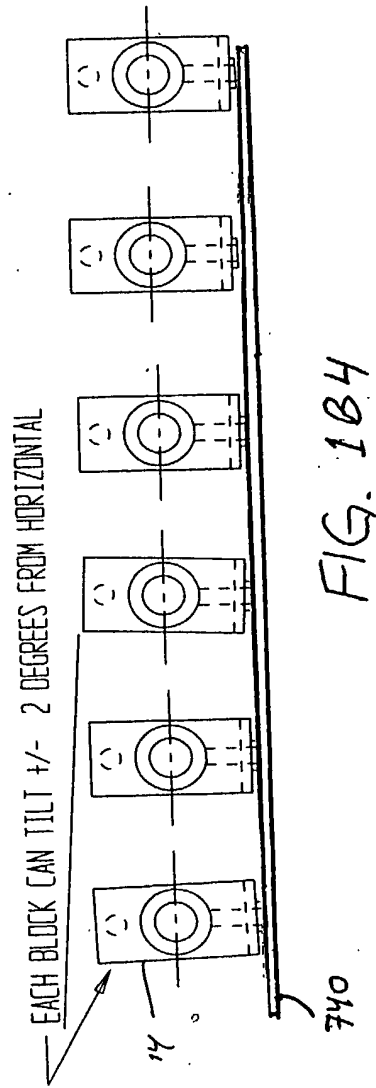
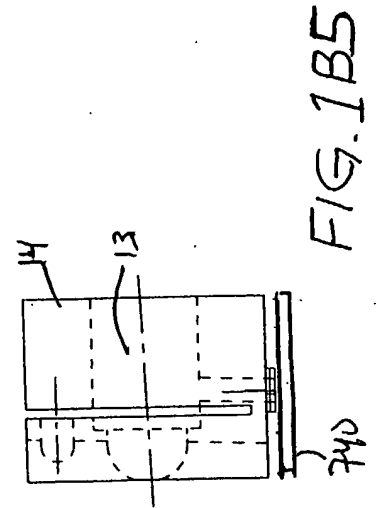


FIG. 1B2

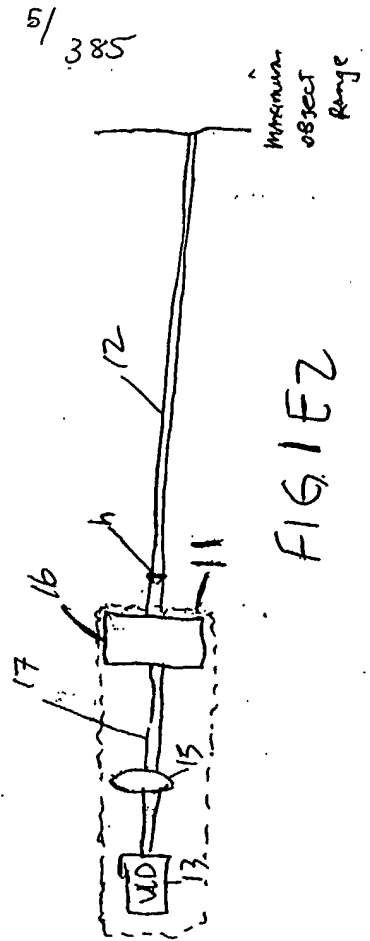
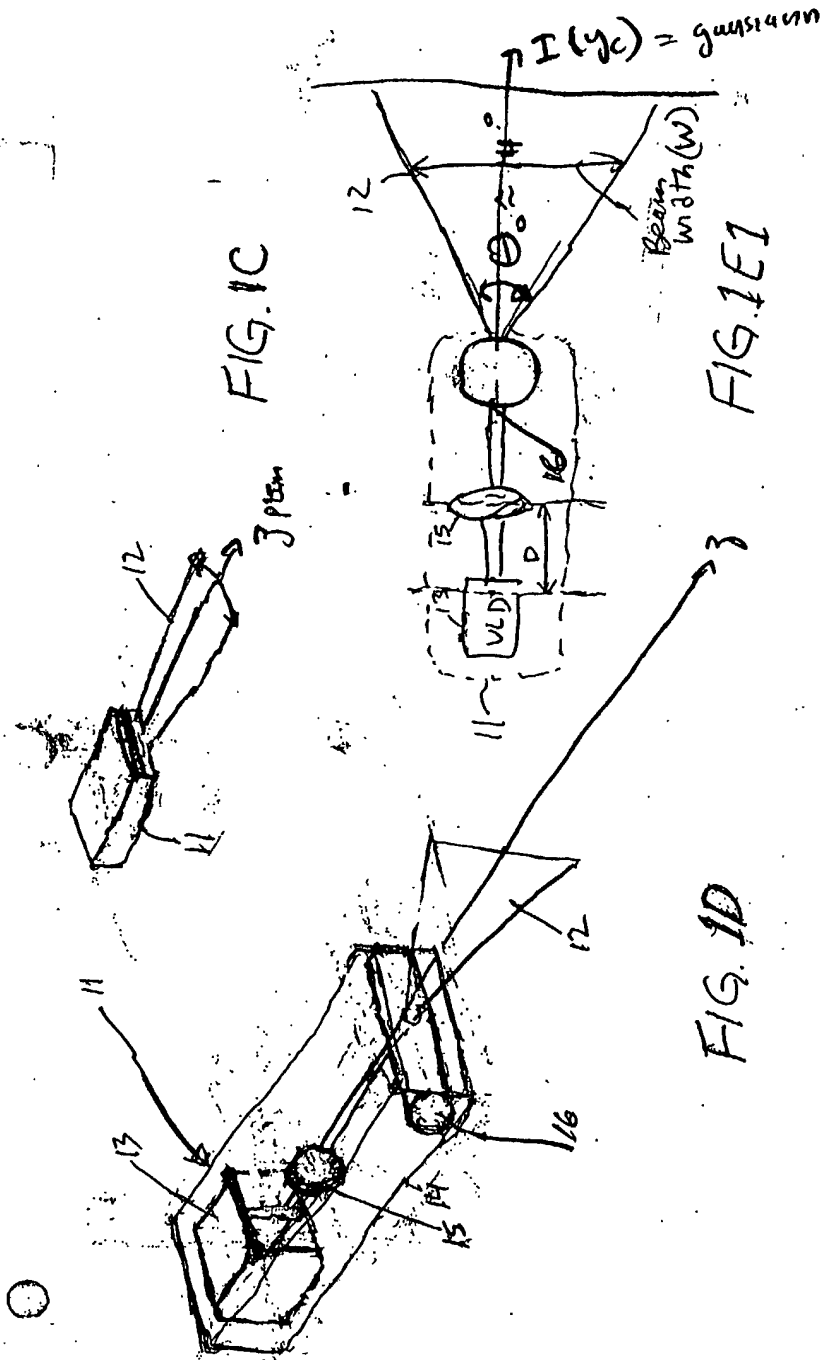
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VLD BLOCK CAN PITCH FORWARD FOR ALIGNMENT WITH OTHER VLD BEAMS







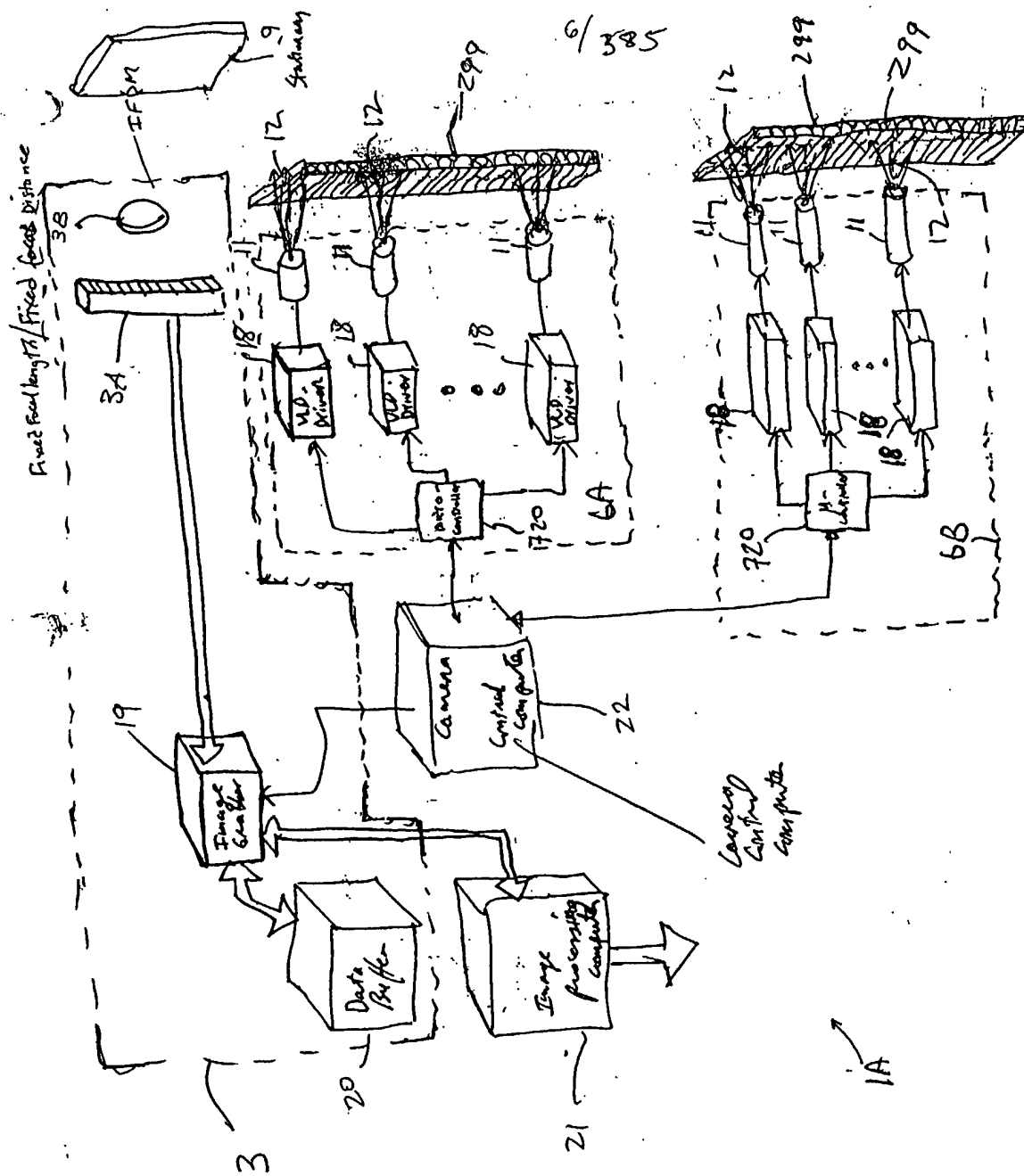
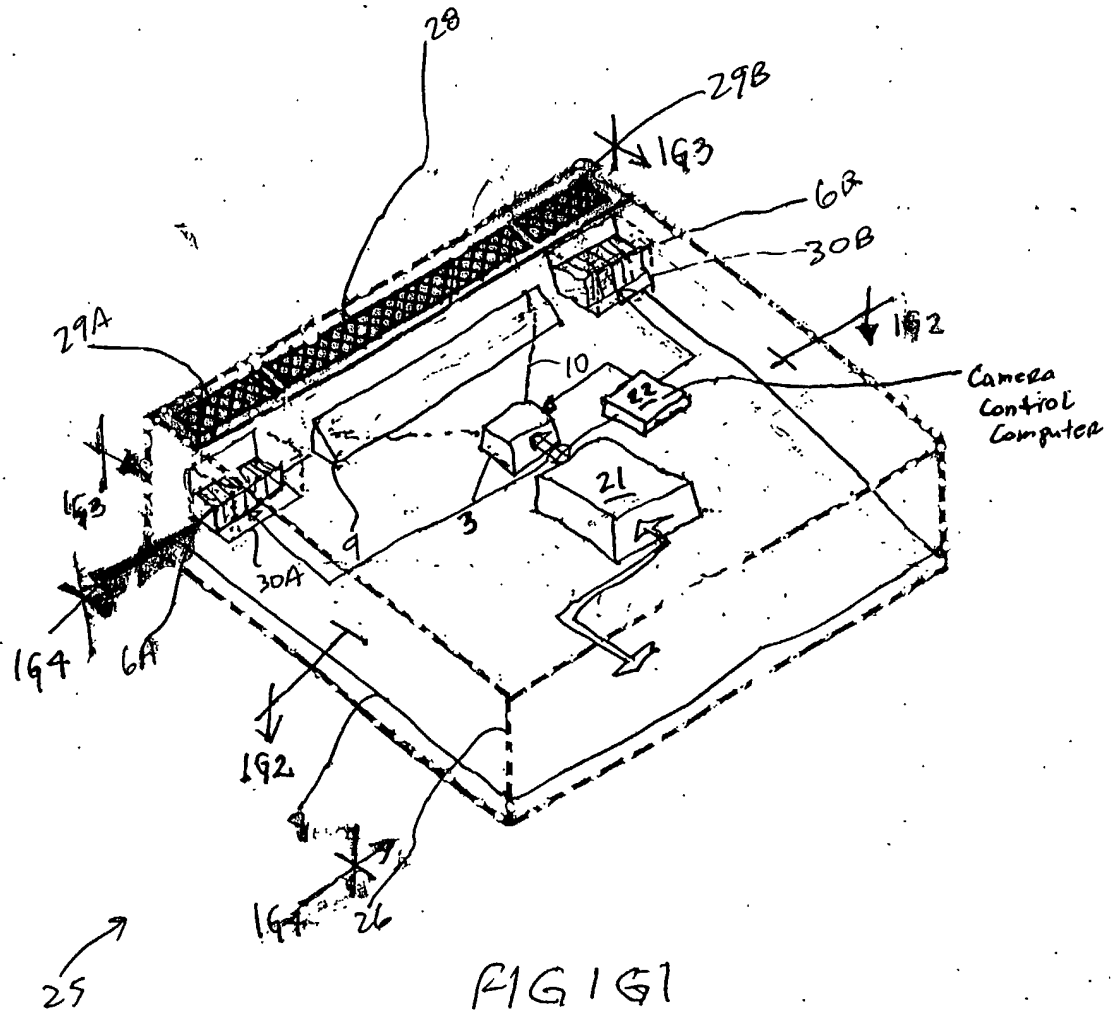


FIG 1

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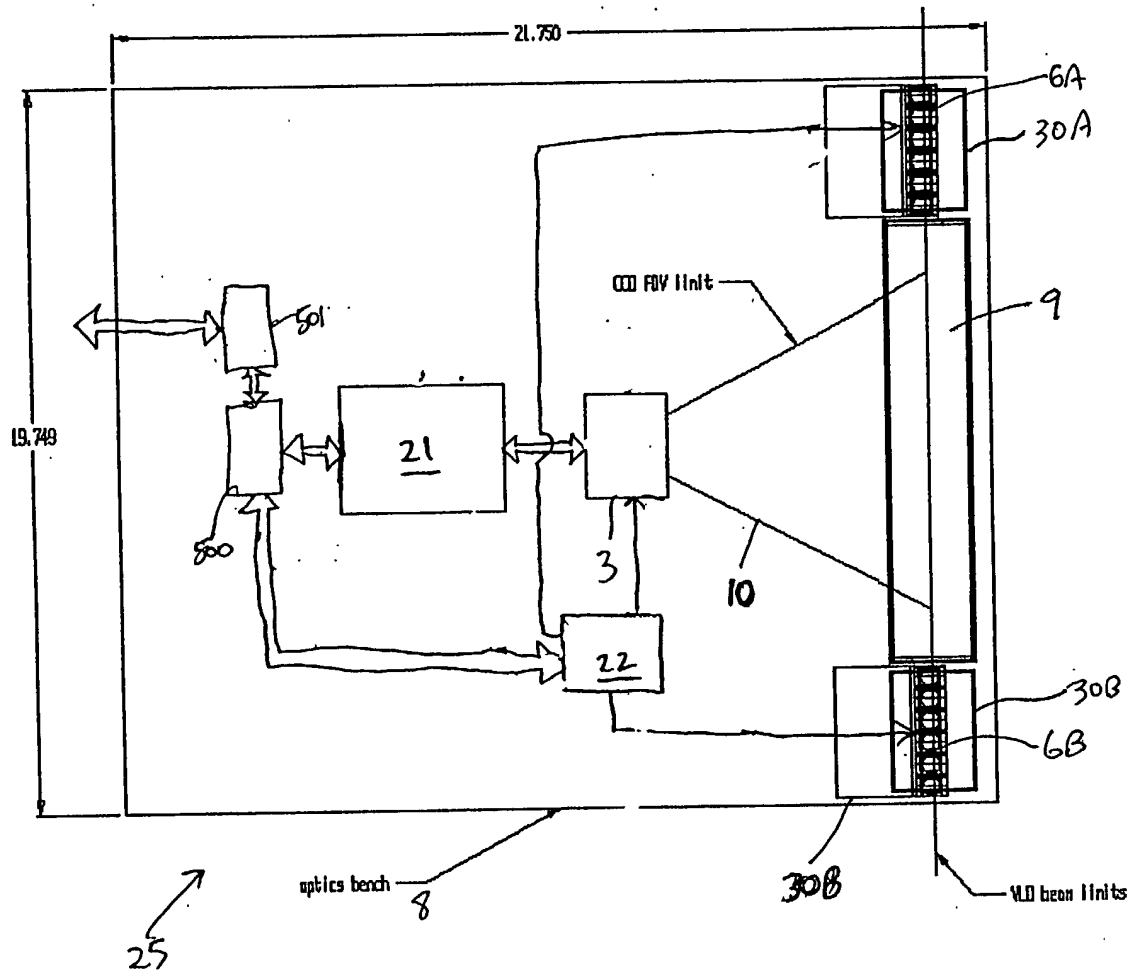
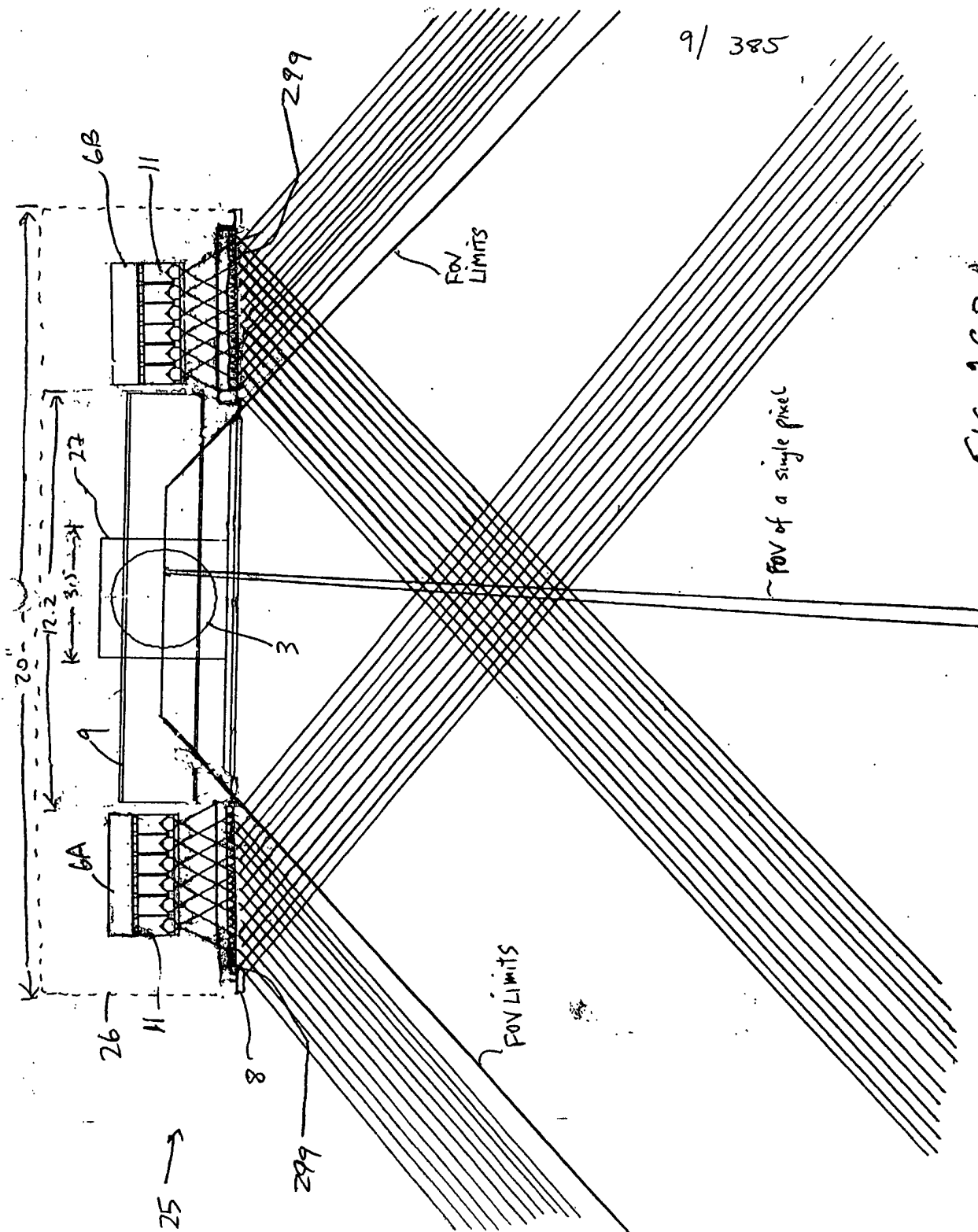


FIG. 142



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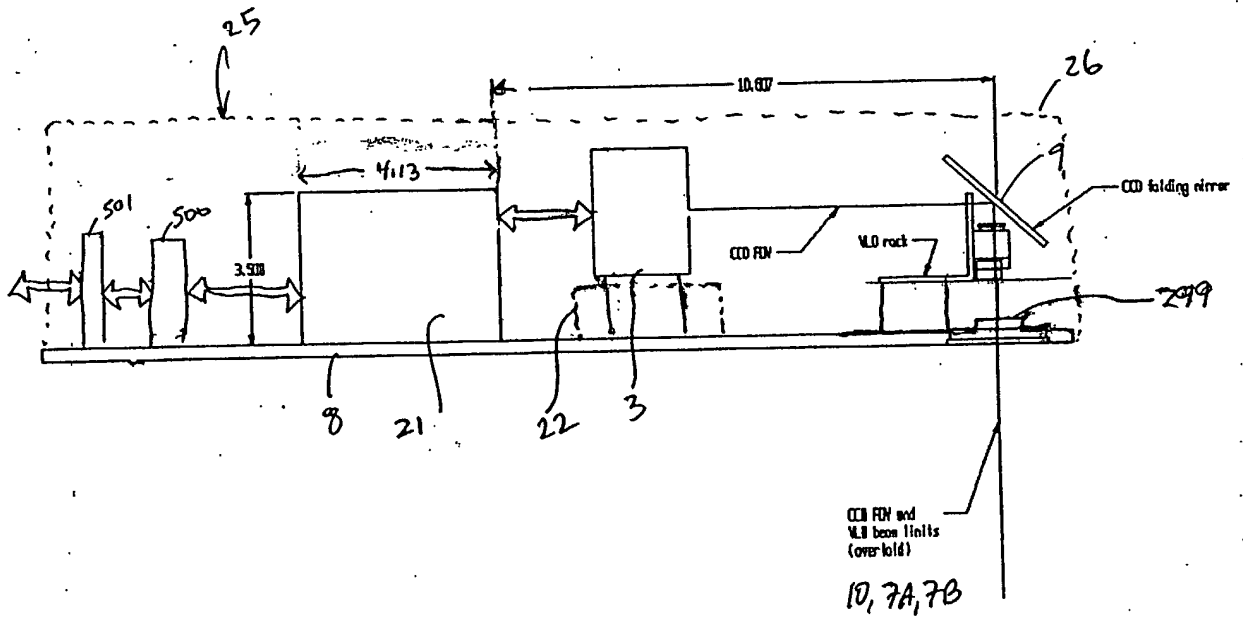
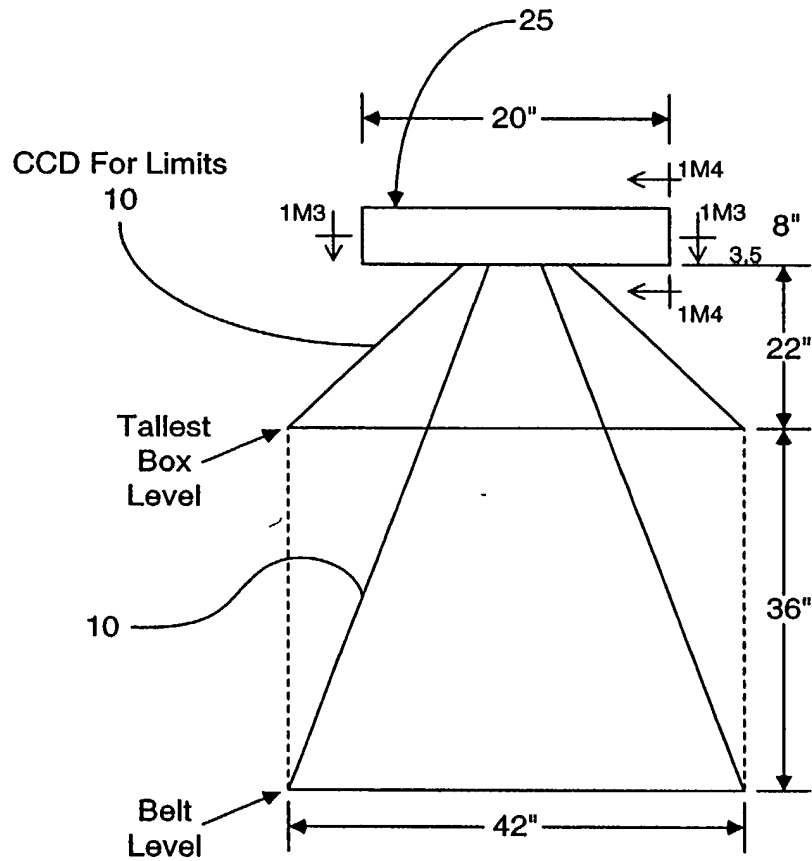


FIG. 164

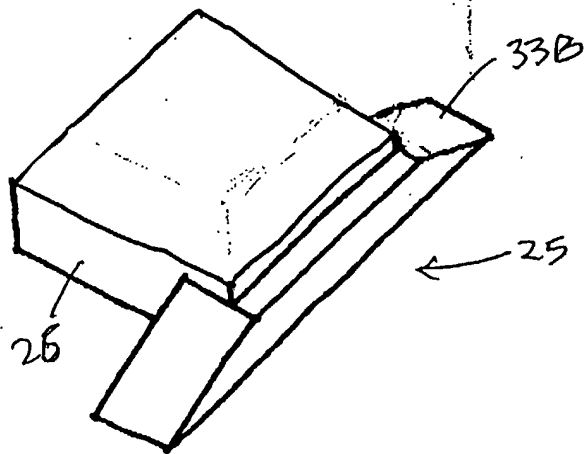
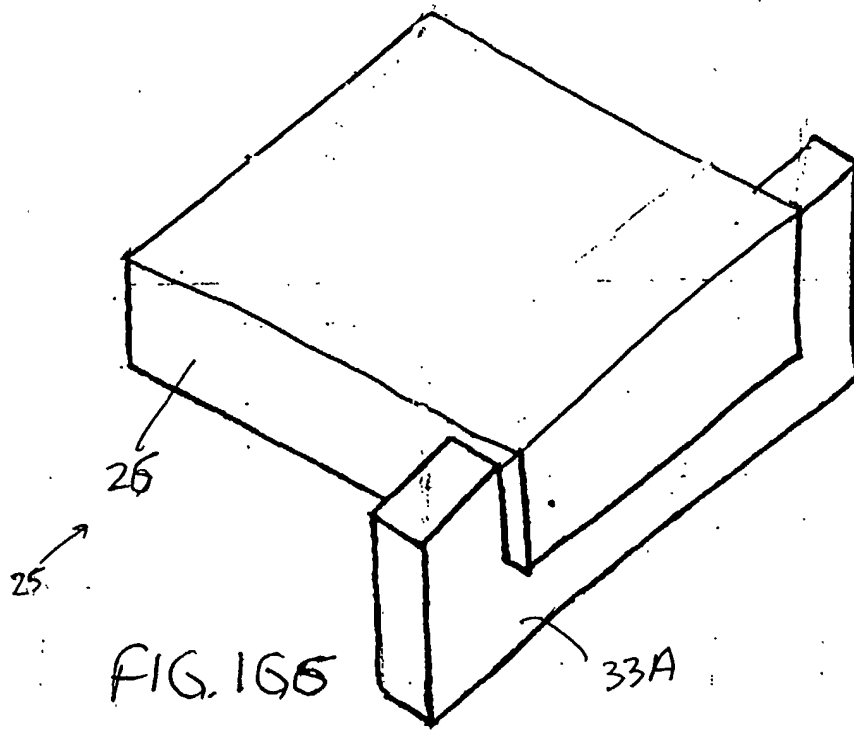
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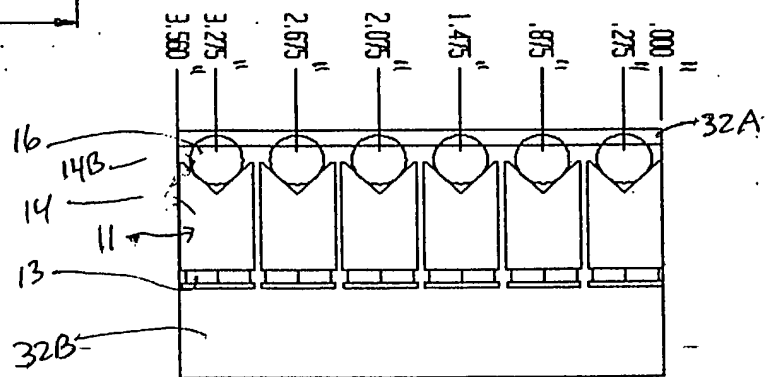
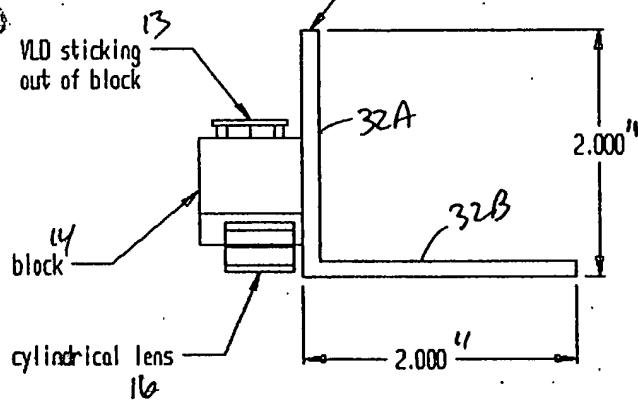
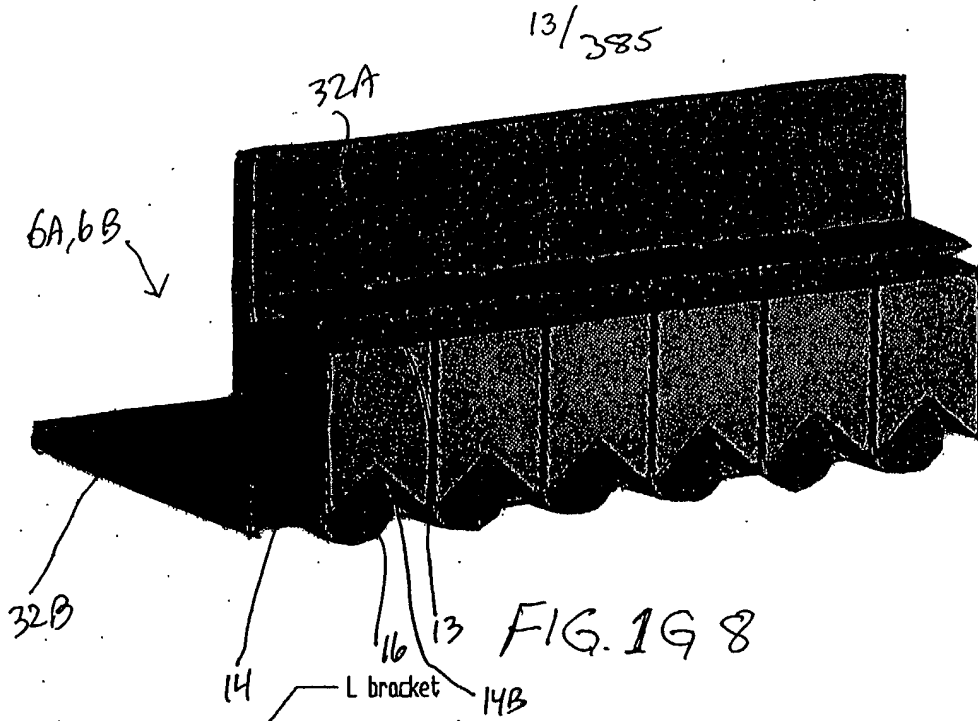
\* Fixed Field Of Field

FIG. 1G5

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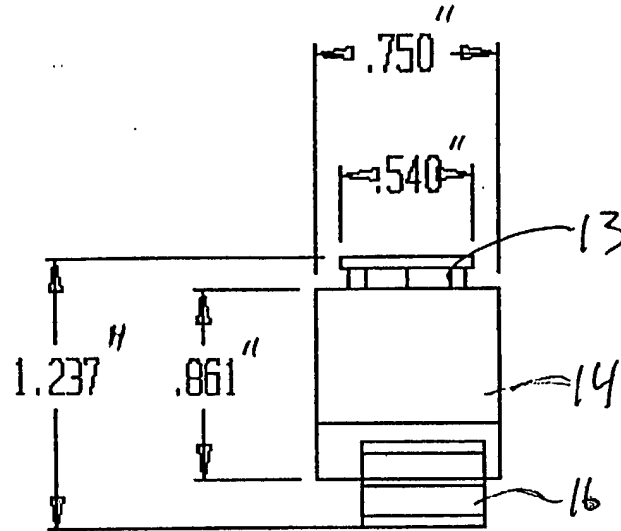


FIG. 1611

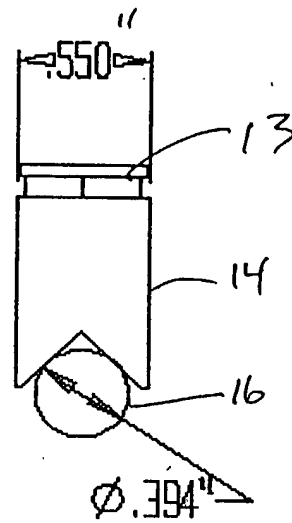


FIG. 1612

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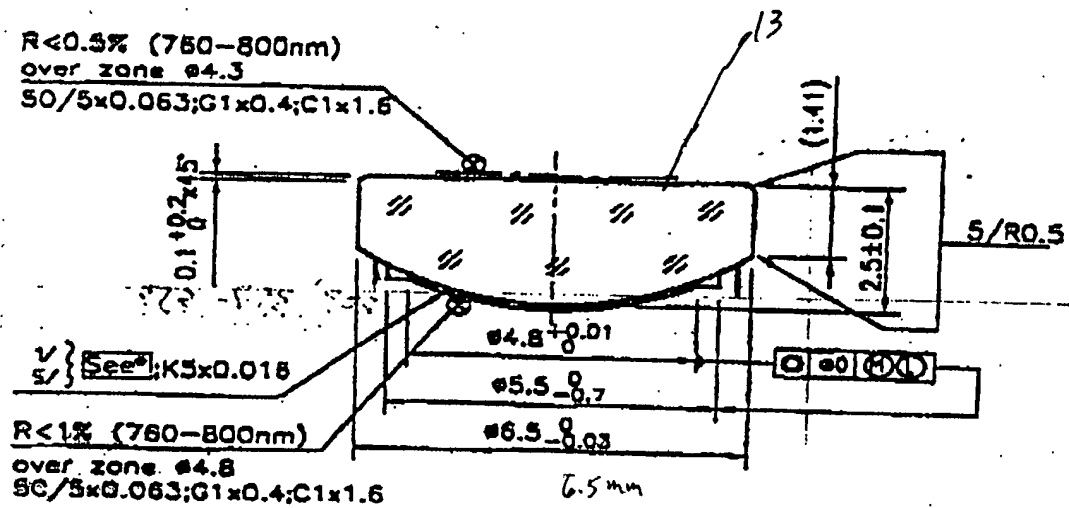


FIG. 1G13

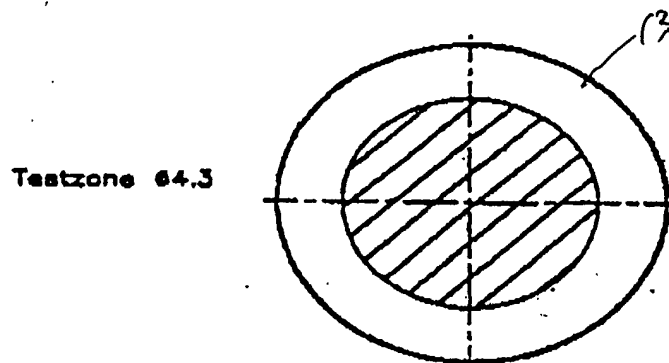


FIG. 1G14

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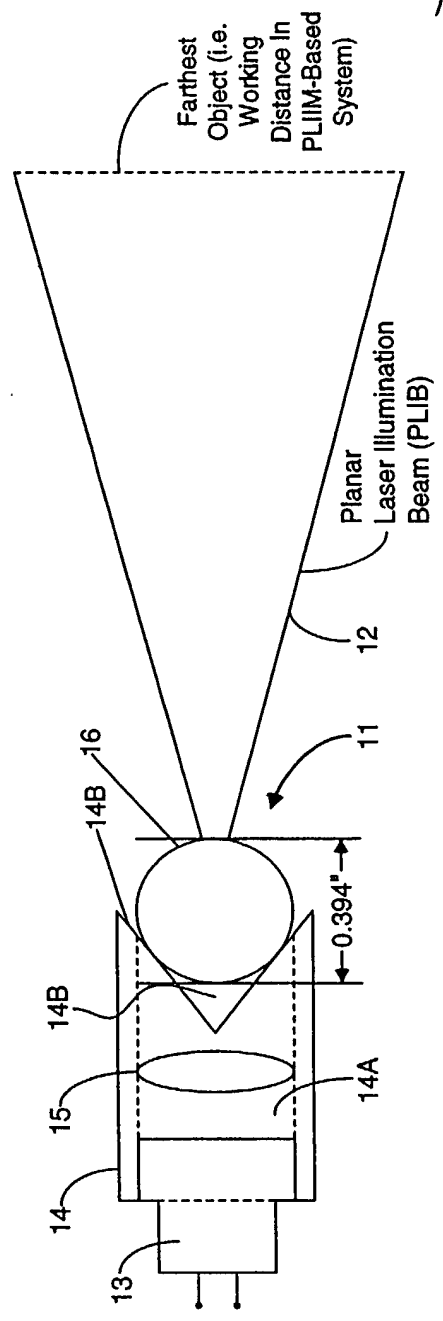


FIG. 1G15A

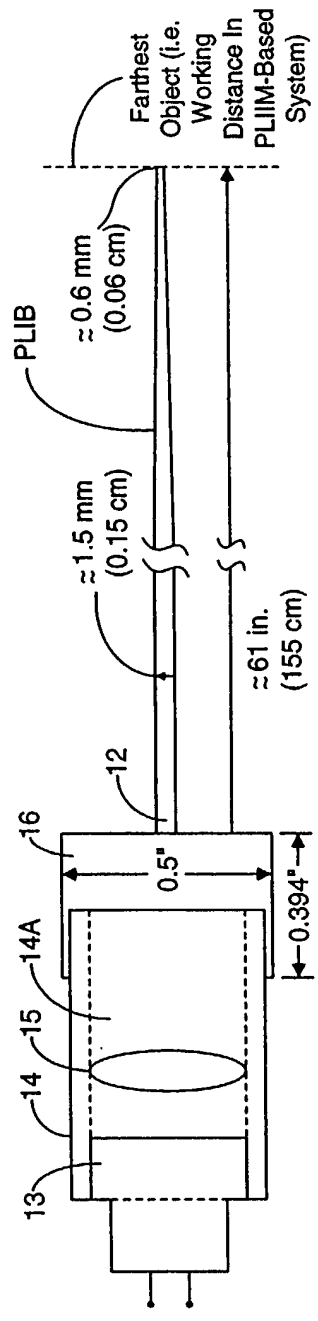


FIG. 1G15B

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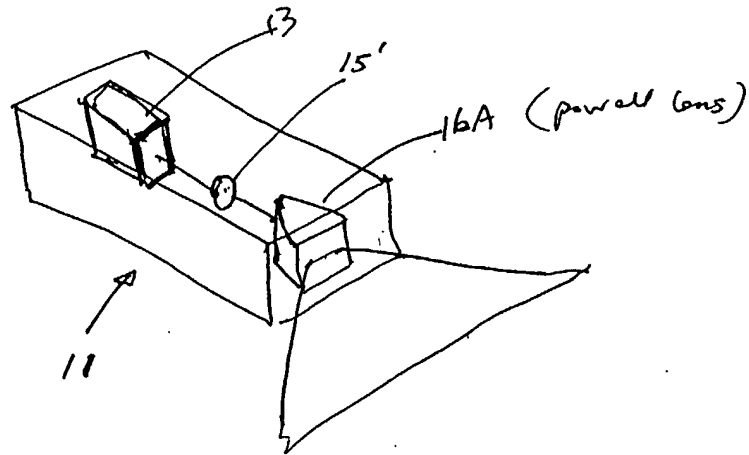


FIG. 1G.16A

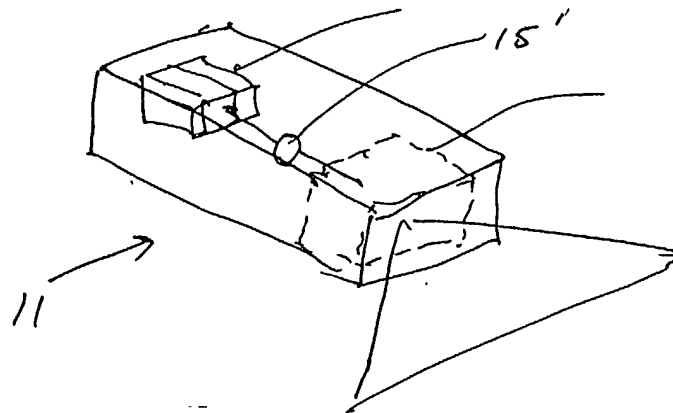


FIG. 1G.16B

PLIM w/  
powell lens

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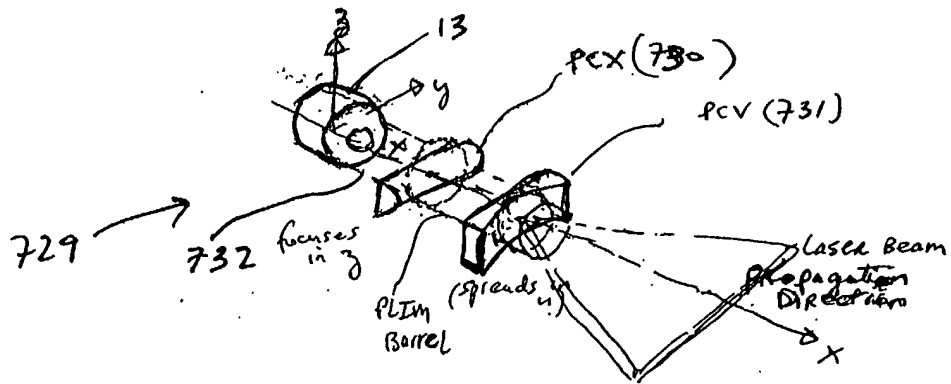


FIG. 16.17A

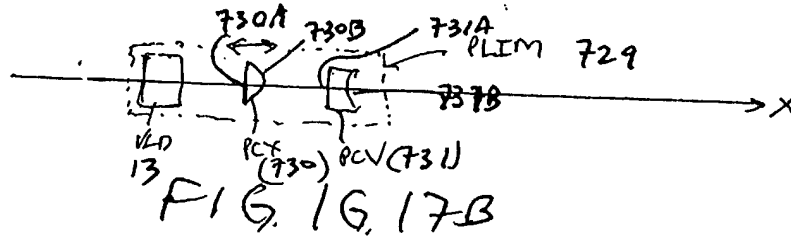


FIG. 16.17B

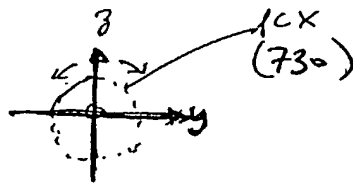


FIG. 16.17C

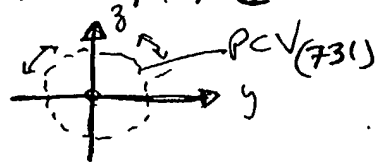


FIG. 16.17D



FIG. 16.17E

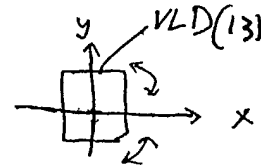


FIG. 16.17F

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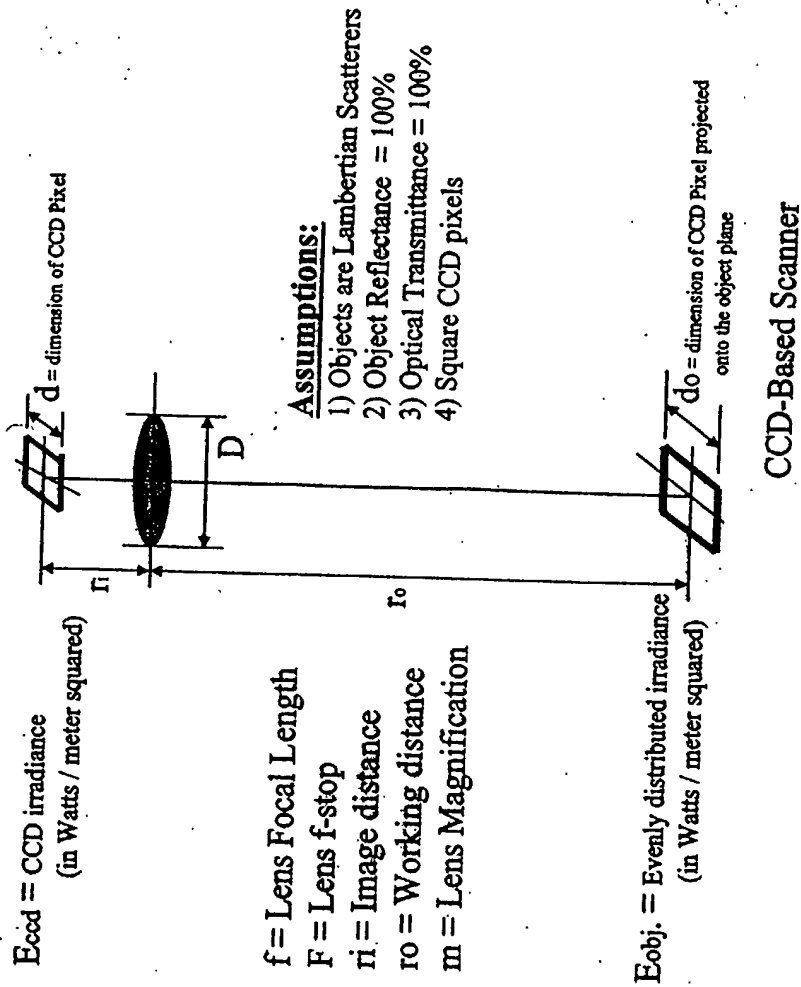


FIG. 146

FIRST GENERALIZED METHOD  
of Reducing Speckle-Noise  
PATTERNS AT IMAGE  
DETECTION ARRAY OF THE  
SPM SYSTEM (3)

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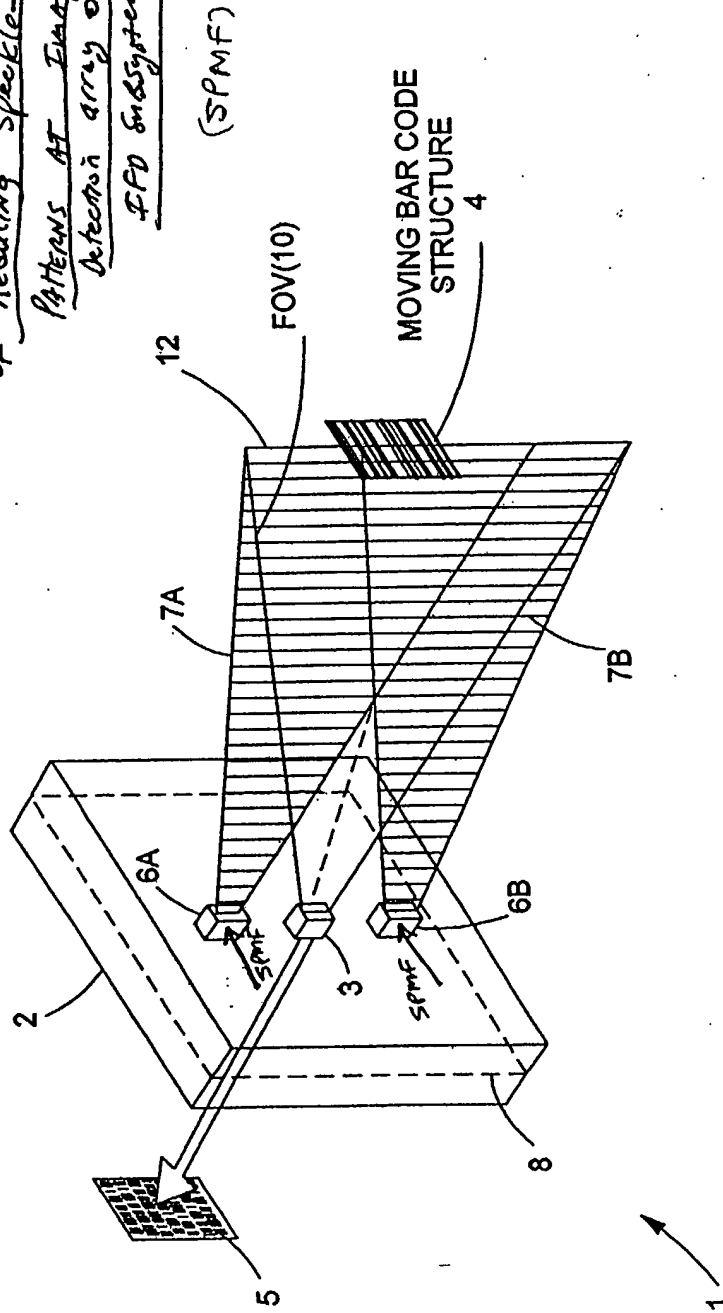
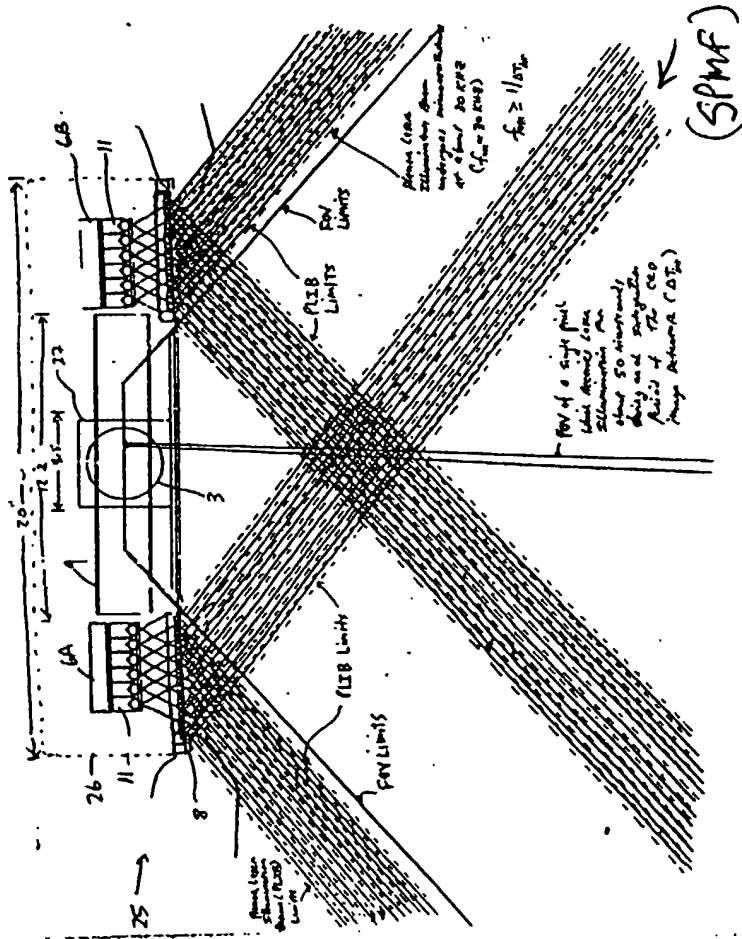


FIG. 1I1



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Prior to object illumination

FIG. 112A

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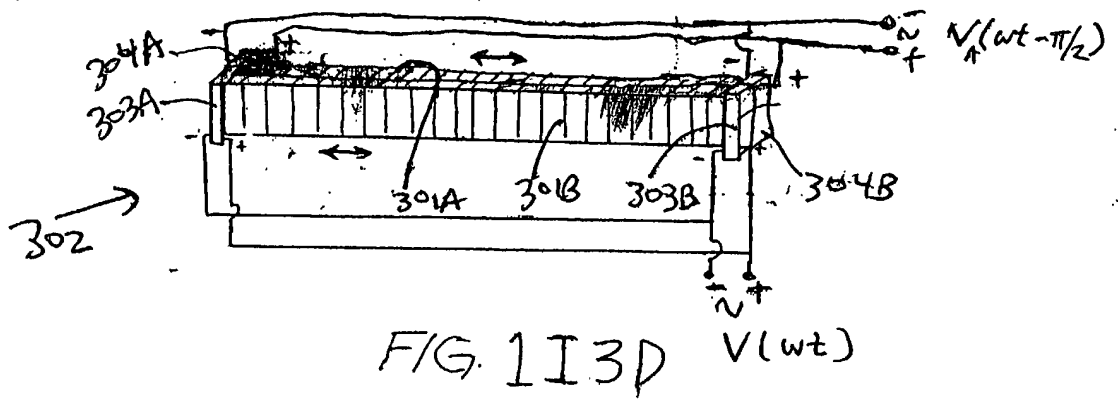
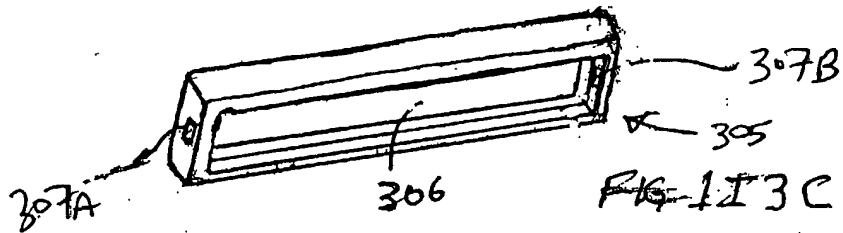
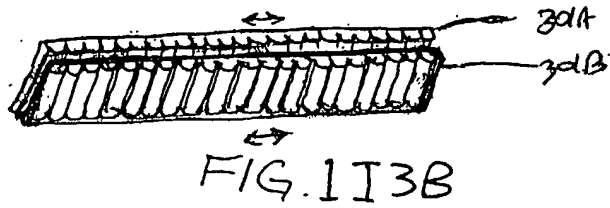
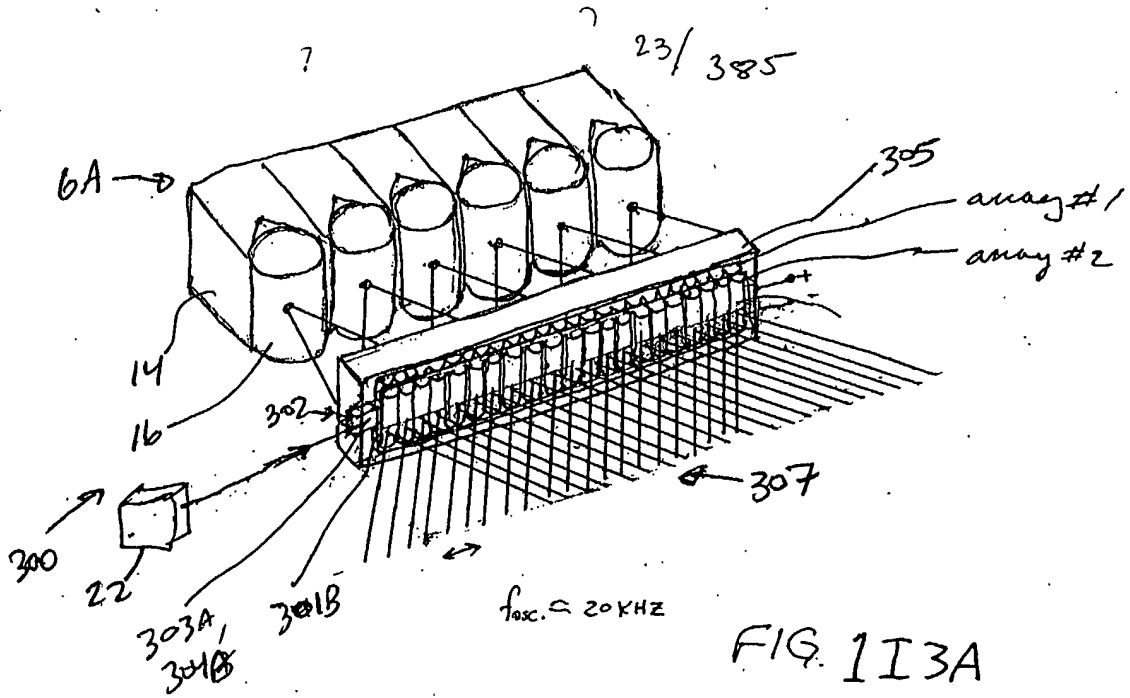
**The First Generalized Speckle-Noise Pattern Reduction Method**  
**Of The Present Invention**

Prior to illumination of the target with the planar laser illumination beam (PLIB), modulate the spatial phase of the transmitted PLIB along the planar extent thereof according to a spatial phase modulation function (SPMF) so as to

produce numerous substantially different time-varying speckle-noise patterns at the image detection array of the IFD Subsystem during the photo-integration time period thereof.

Temporally average the numerous substantially different time-varying speckle-noise patterns produced at the image detection array in the IFD Subsystem during the photo-integration time period thereof, so as to thereby reduce the power of the speckle-noise pattern observed at the image detection array.

FIG. 1I2B



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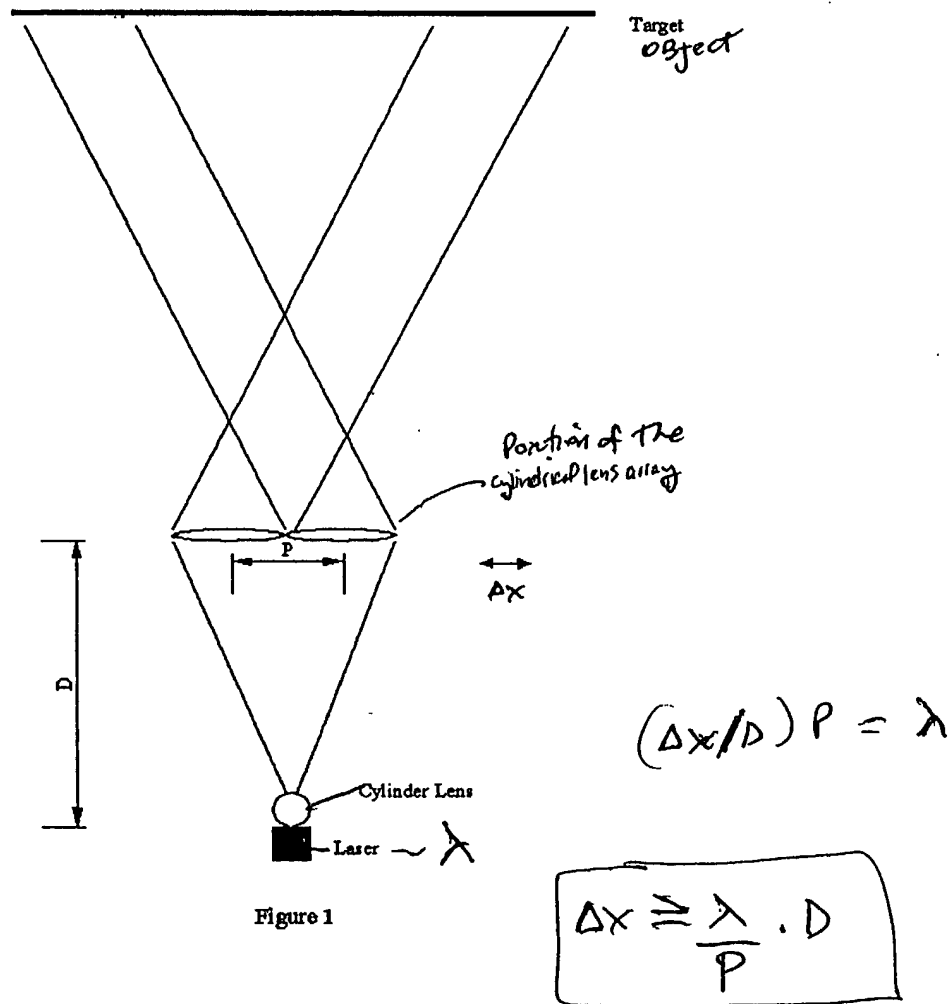


FIG. 1I3E

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FIG. 1I3F

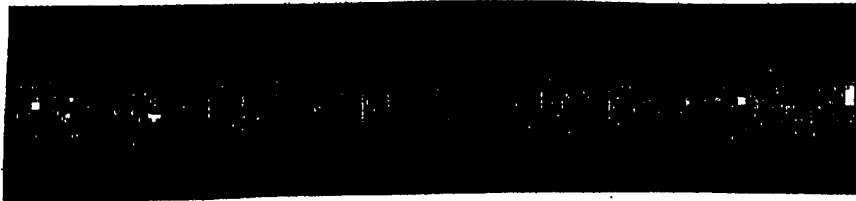
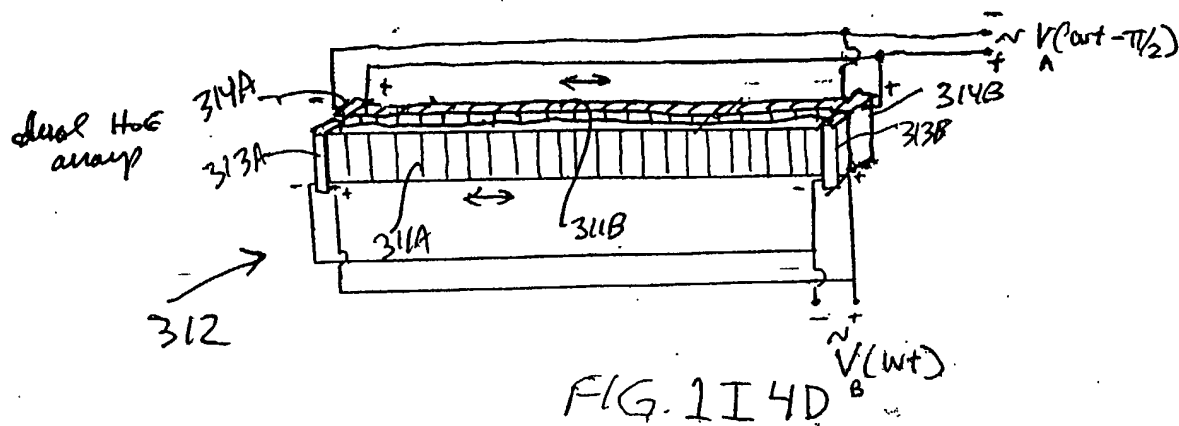
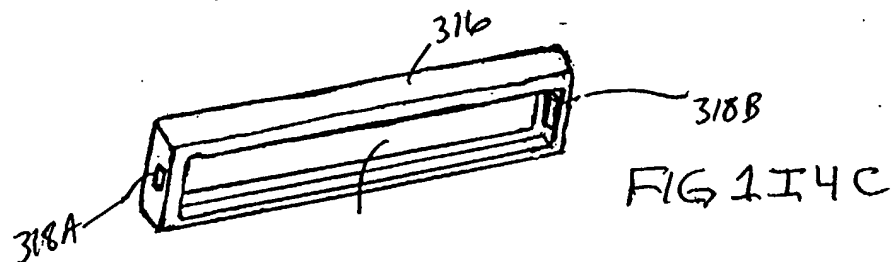
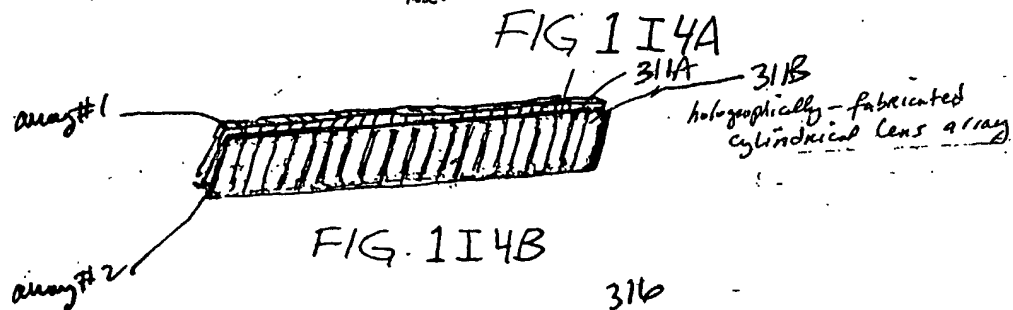
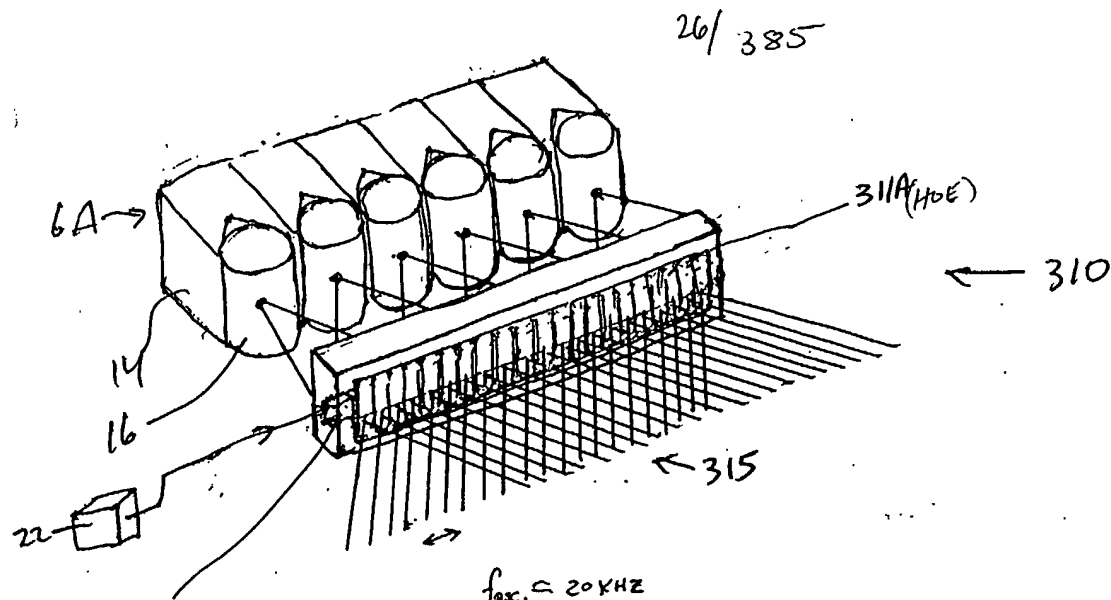
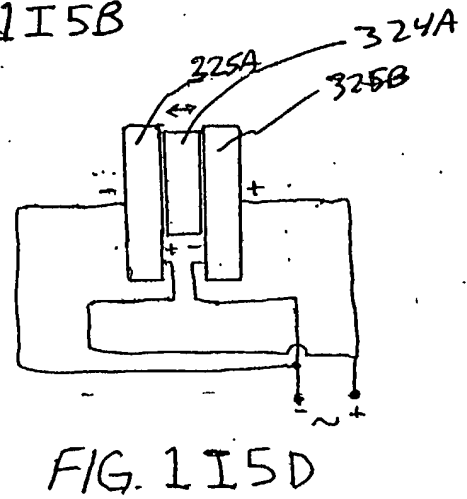
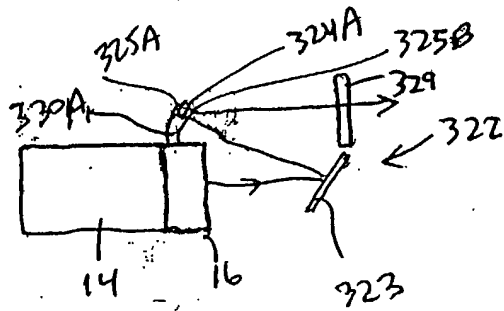
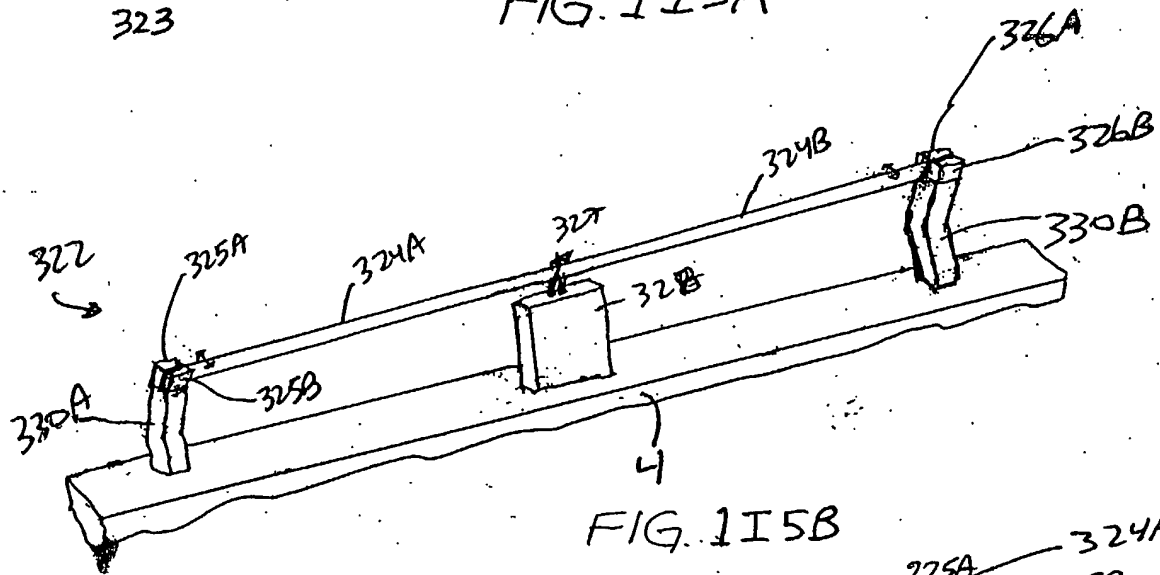
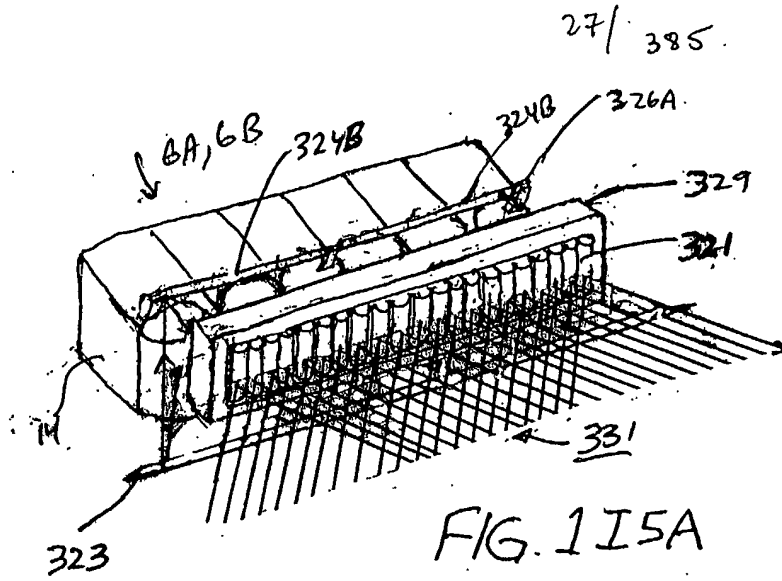
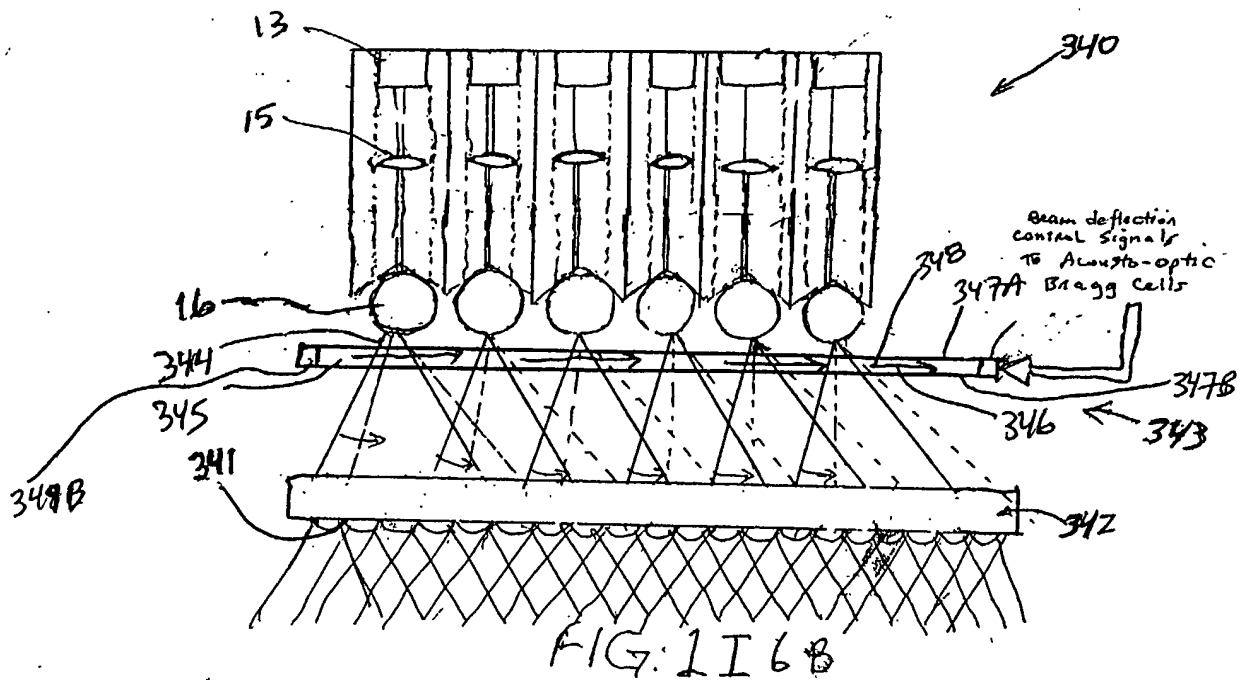
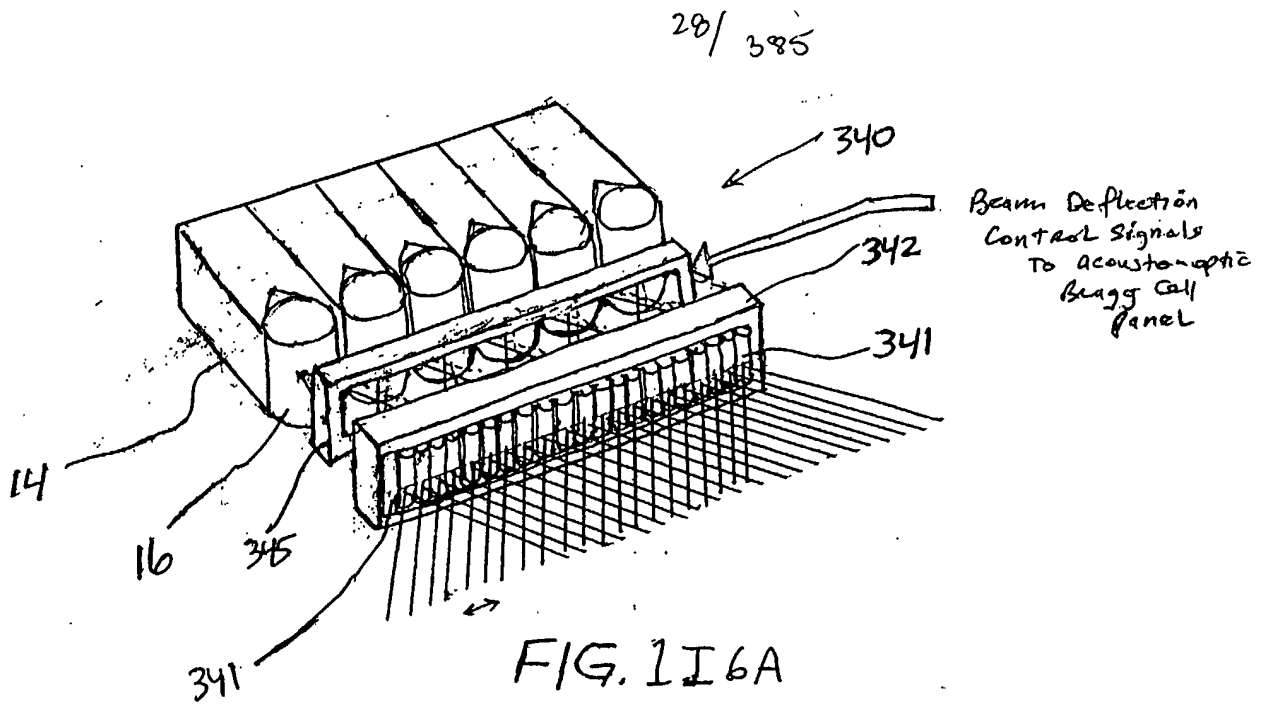


FIG 1I3G

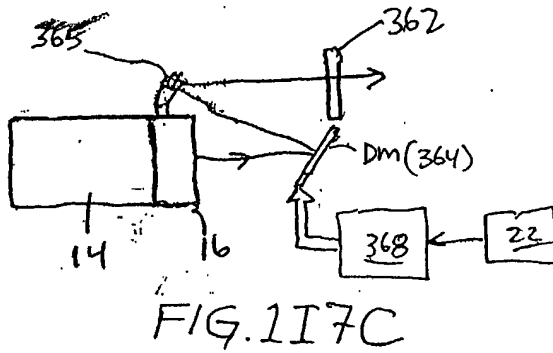
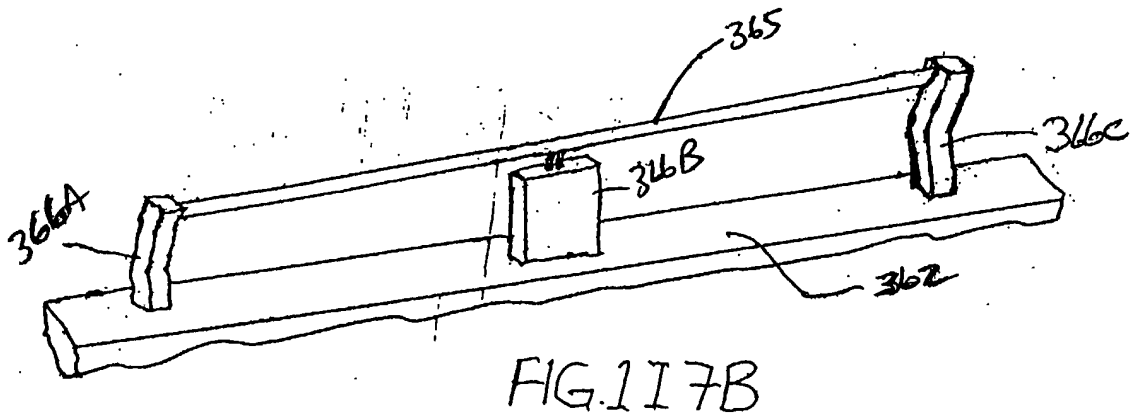
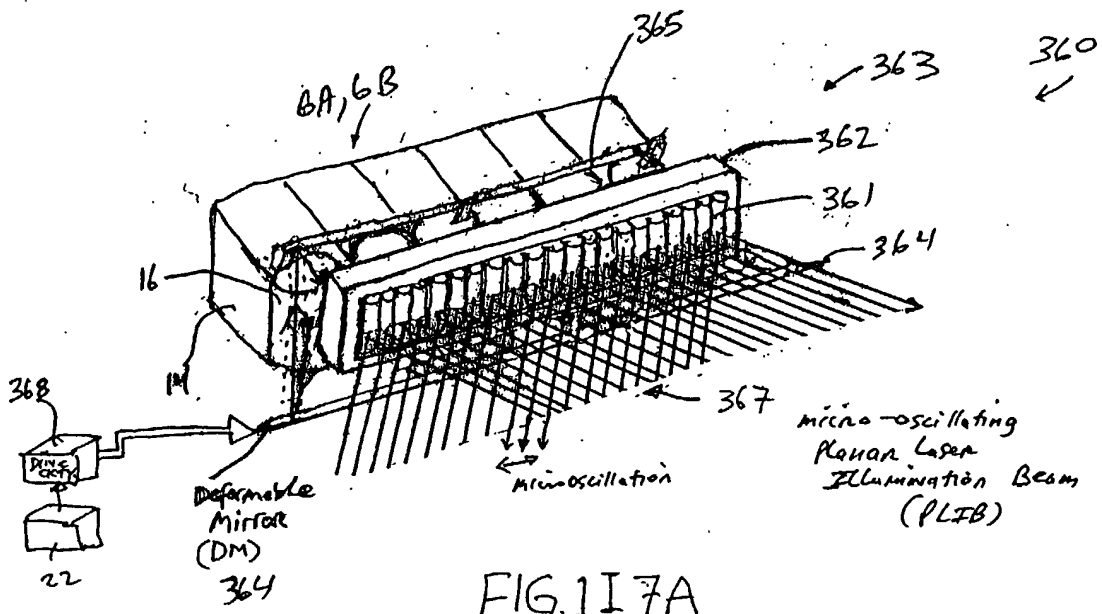


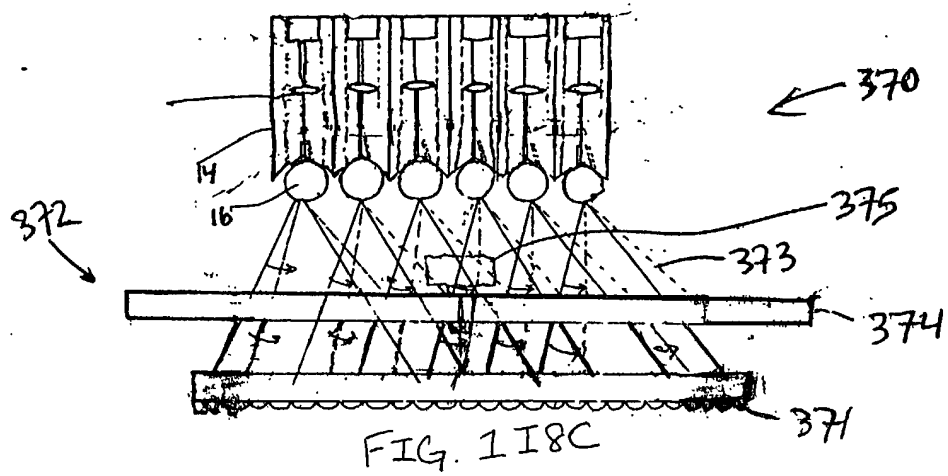
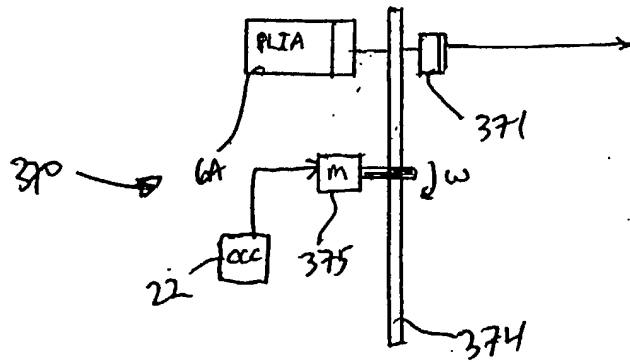
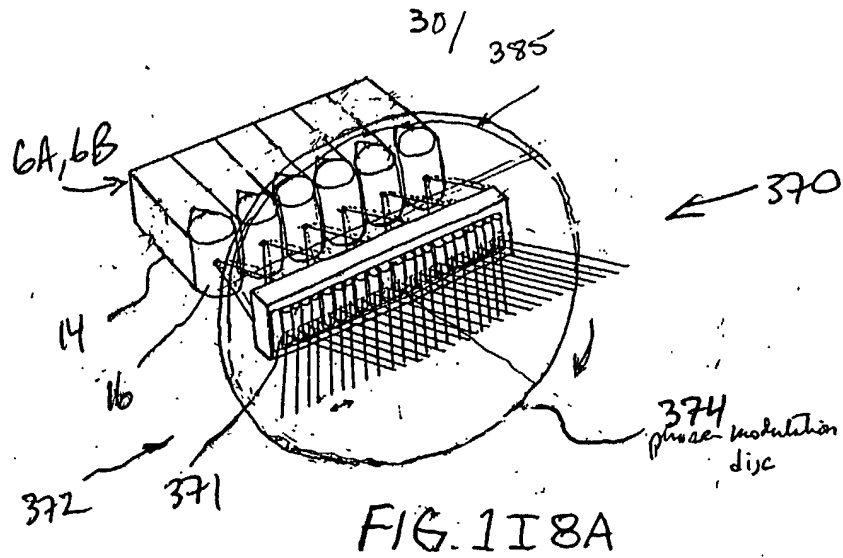




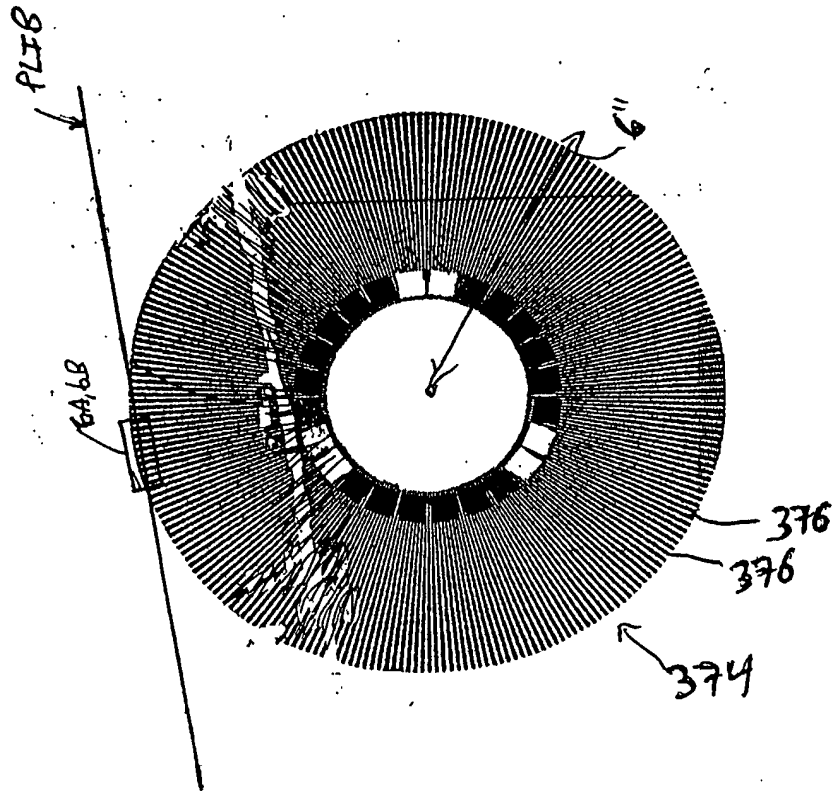
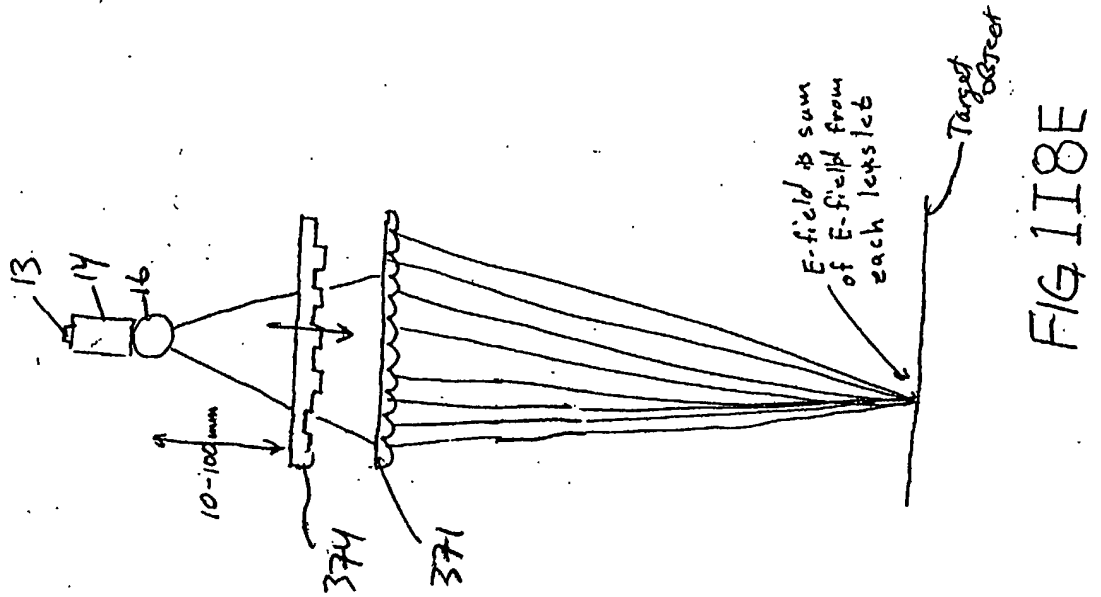


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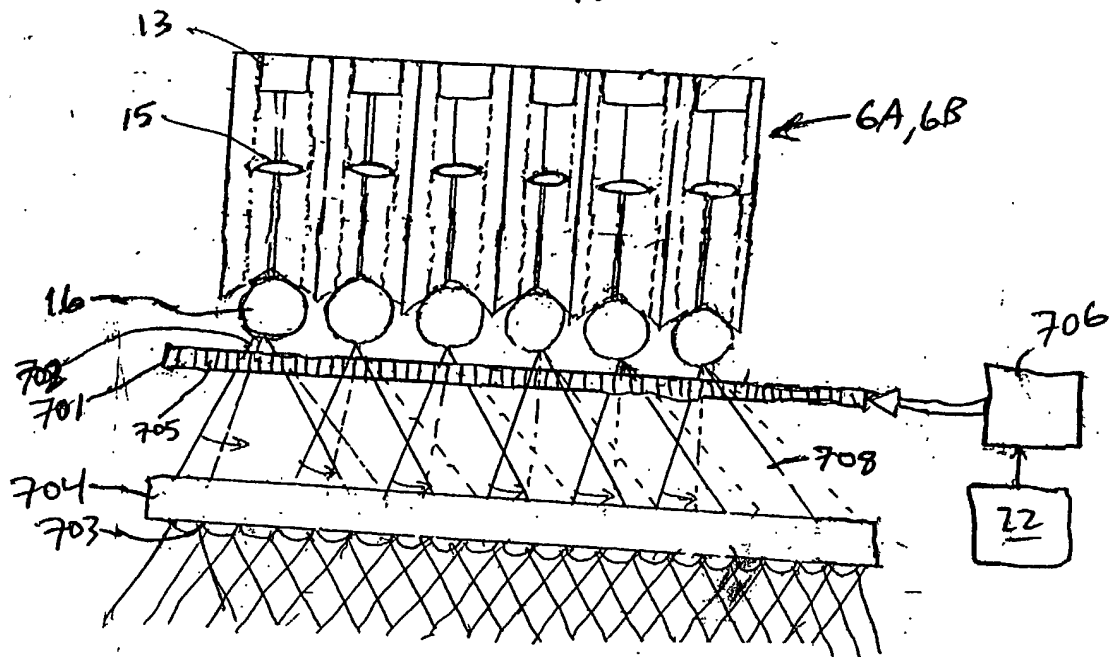
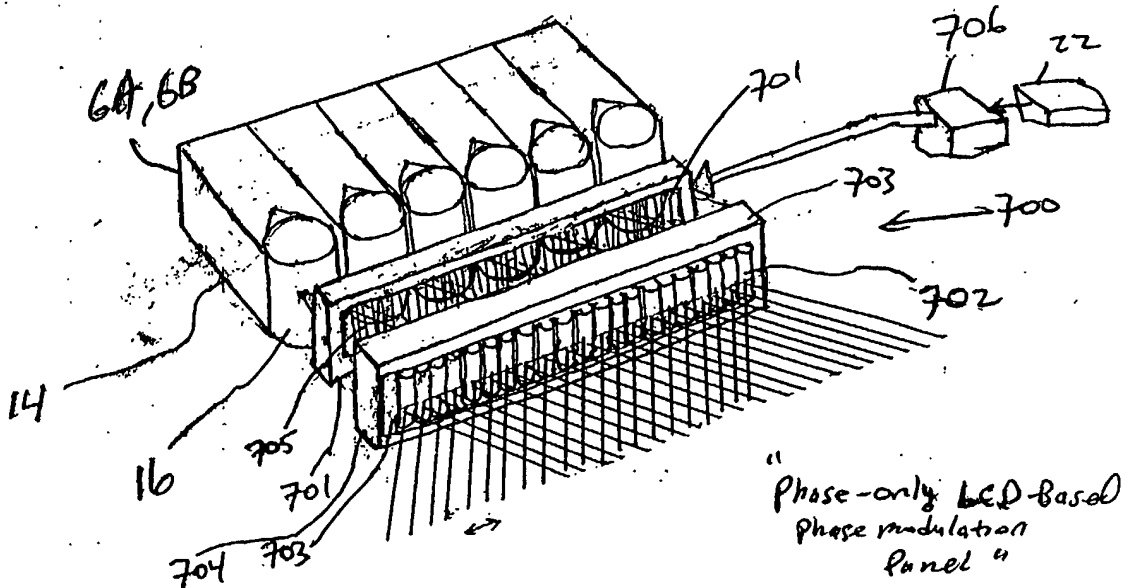




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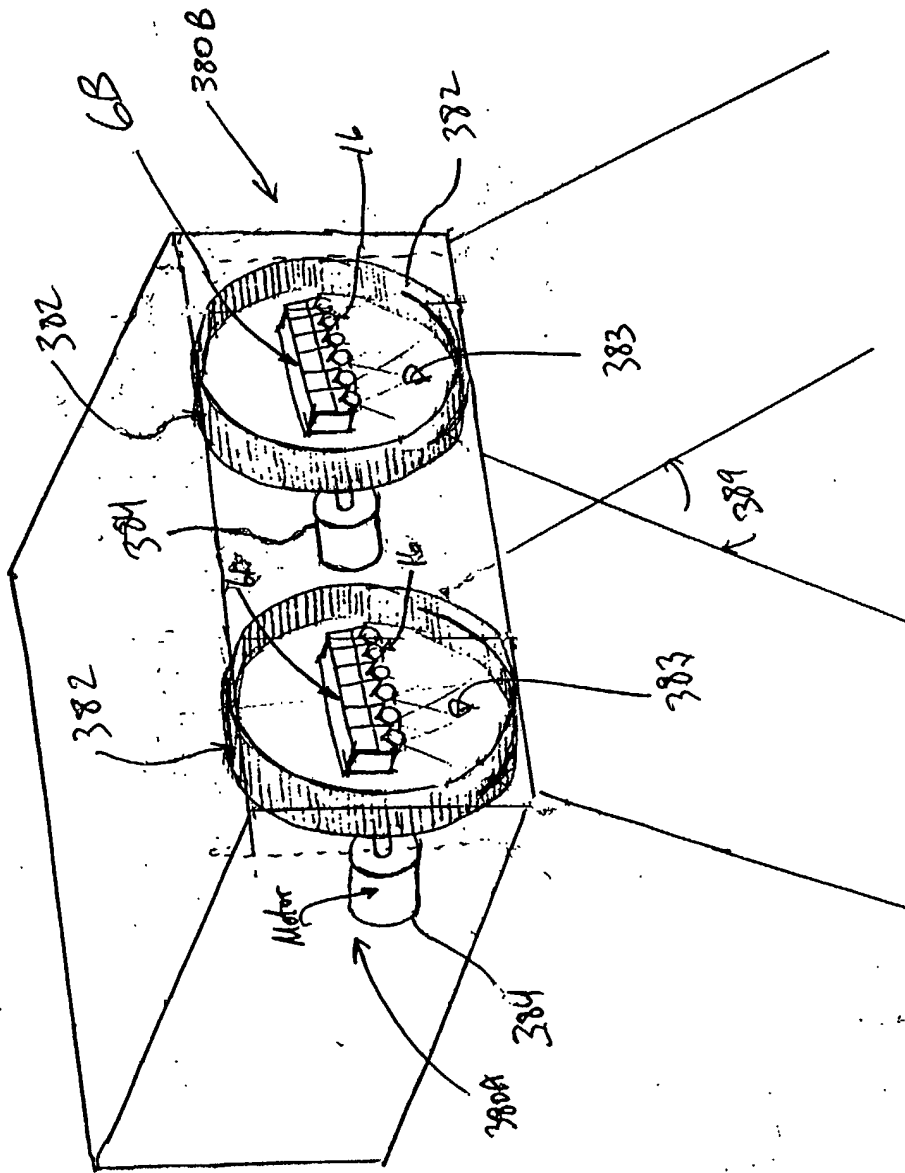


FIG. 11 9A

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Optical specifications:

- 30 cylindrical lens (lens) per linear inch
- focal length  $\approx 2.0$  millimeters
- diameter of lens  $\approx 4$  inches
- acrylic material

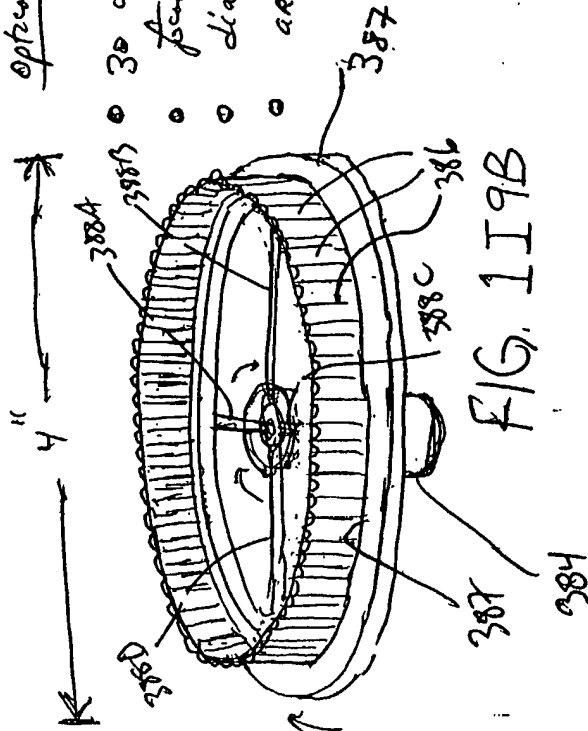


FIG. 1I9B

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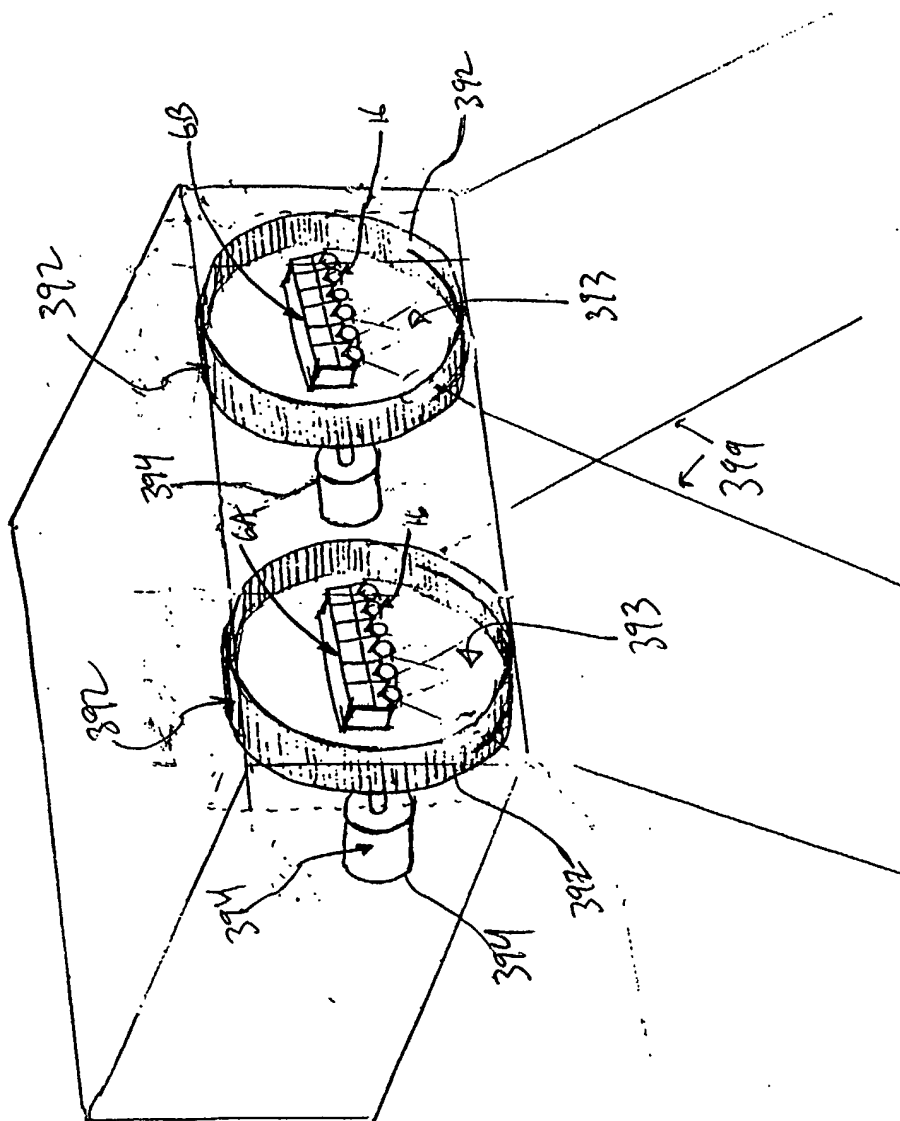


FIG. 1I10A

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Optical specifications:

- 30 upturned lens (lens) per linear inch
- foil length  $\approx$  2.0 millimeters
- diameter of conductive cross  $\approx$  4 inches

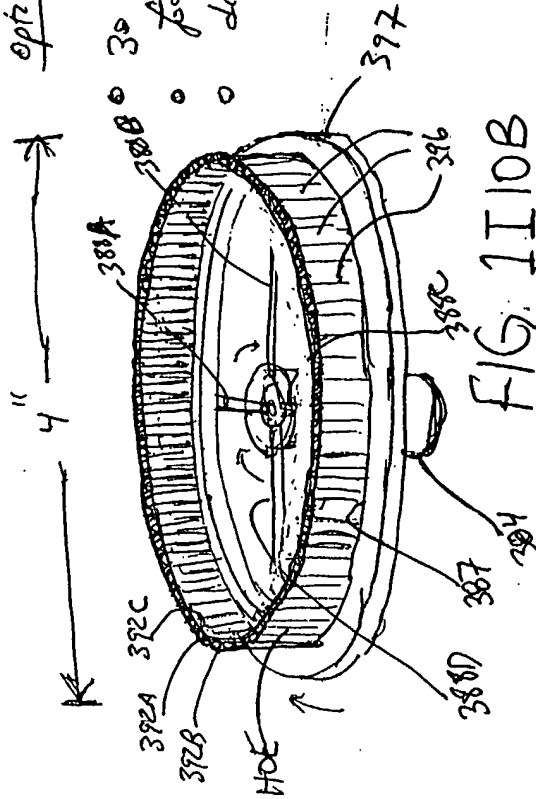


FIG. 1110B



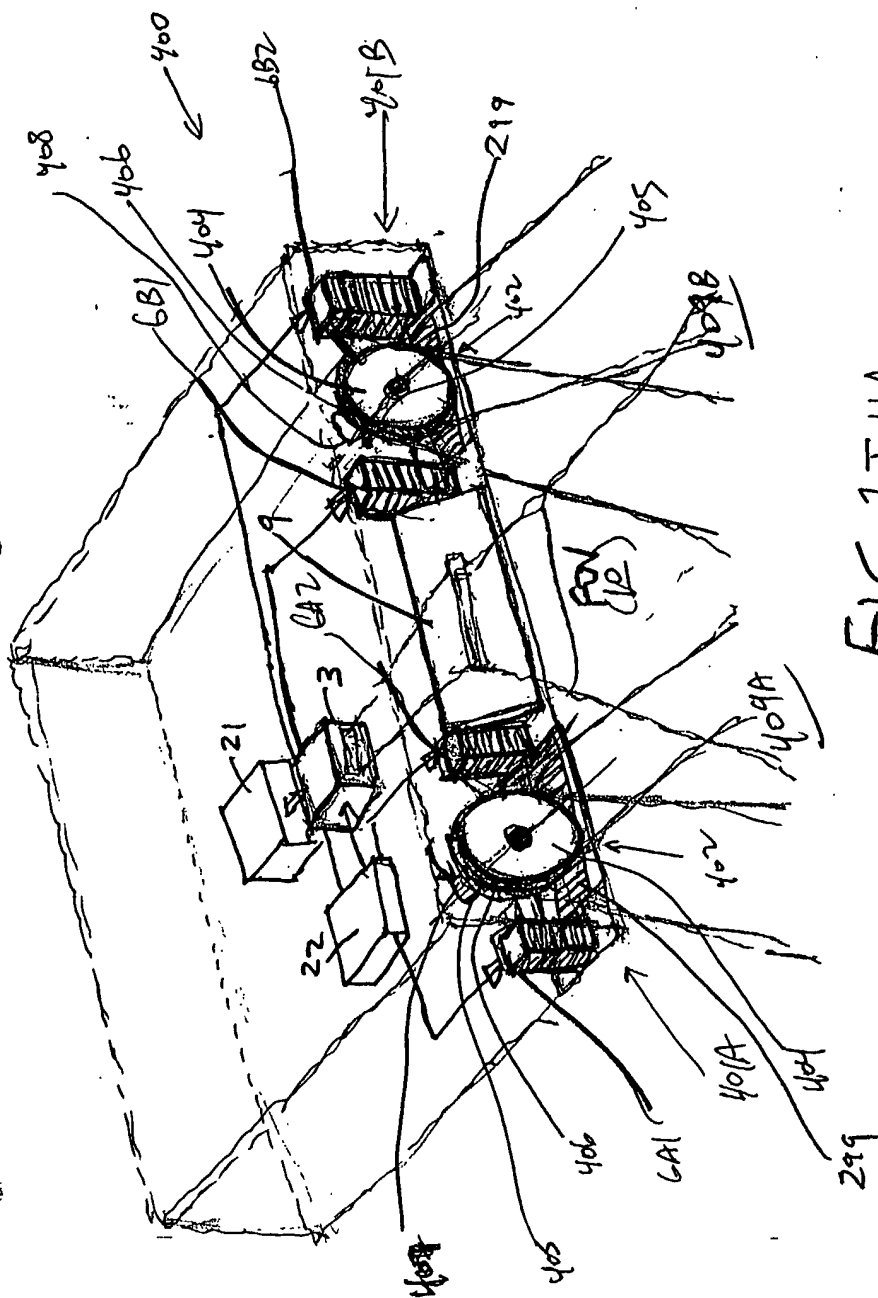


FIG. 11A

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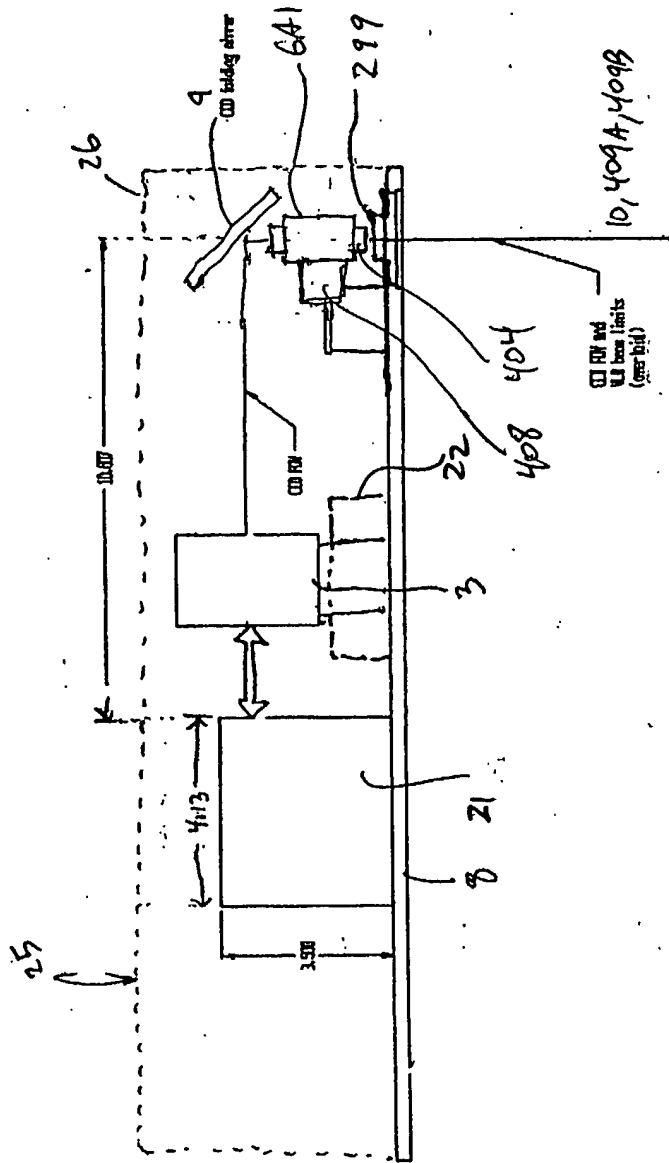


FIG 1I11B

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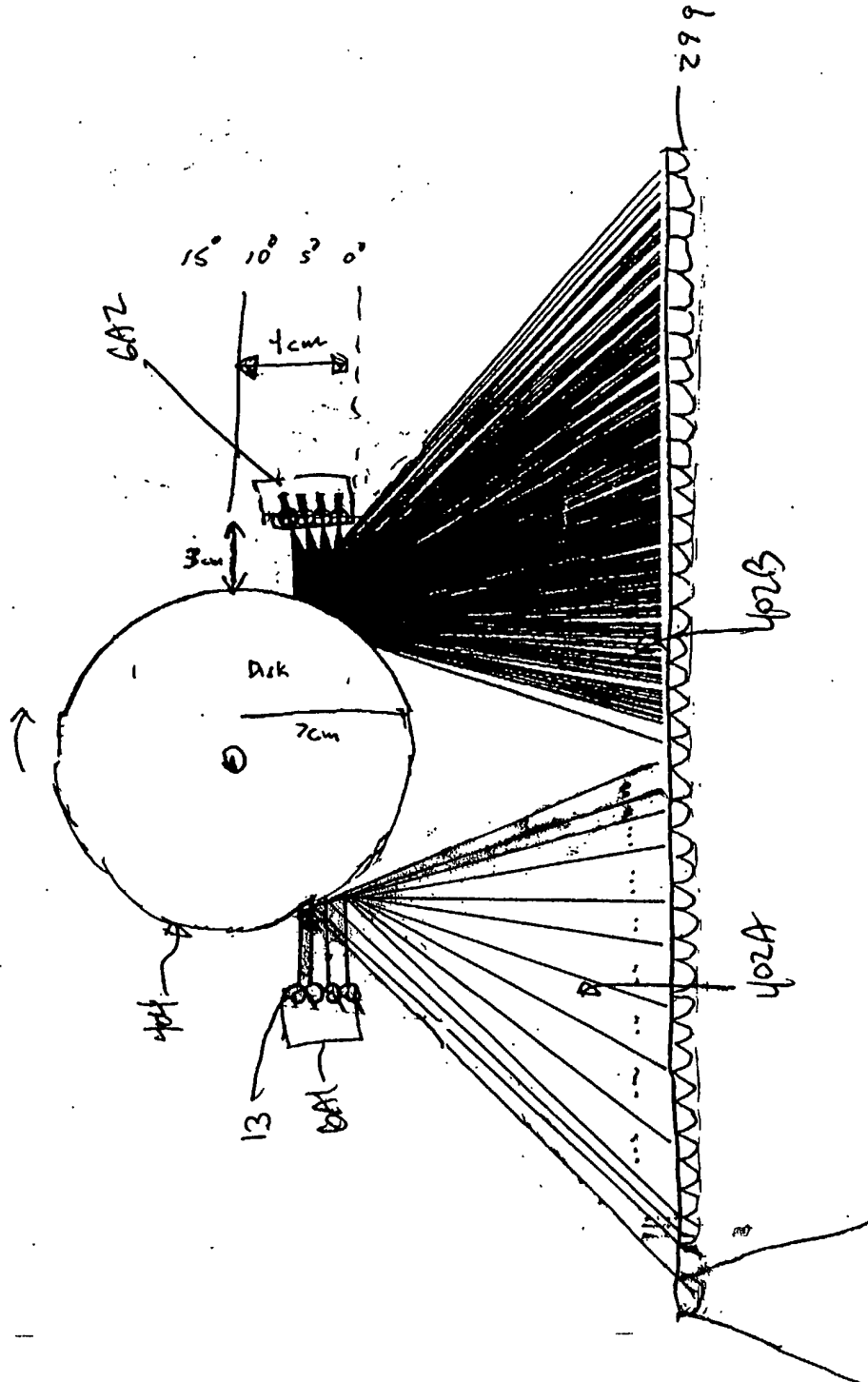


FIG. 1111C

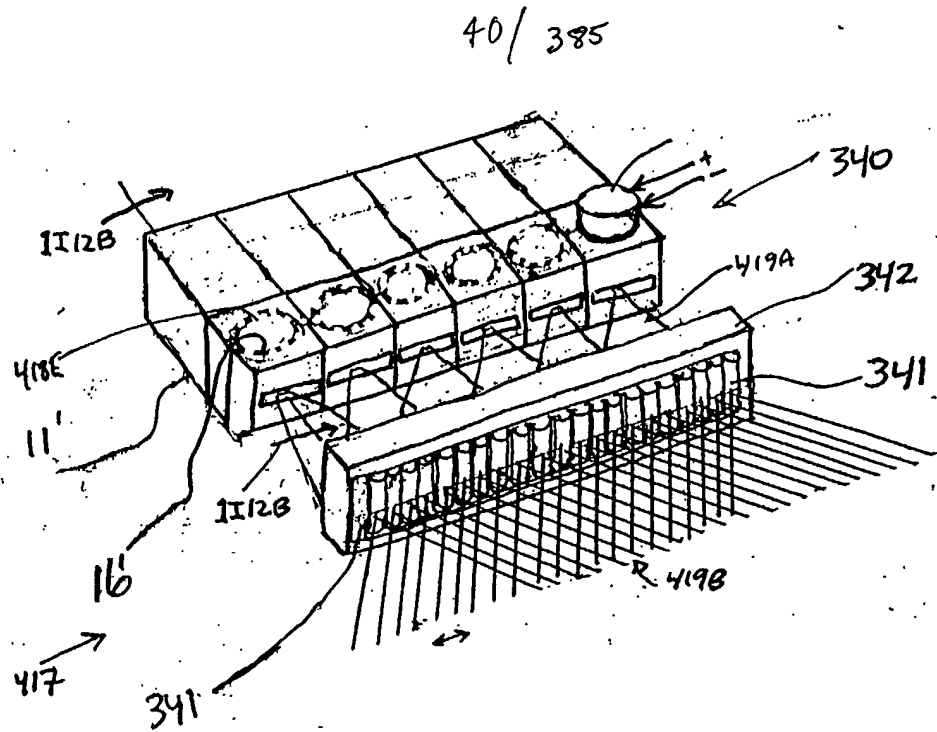


FIG. 1I12A

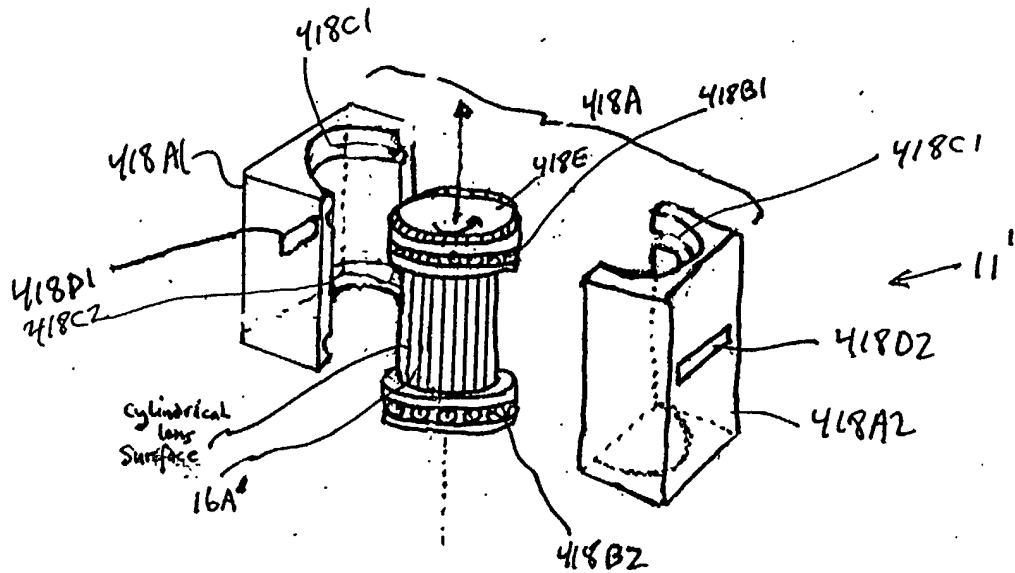


FIG. 1I12B

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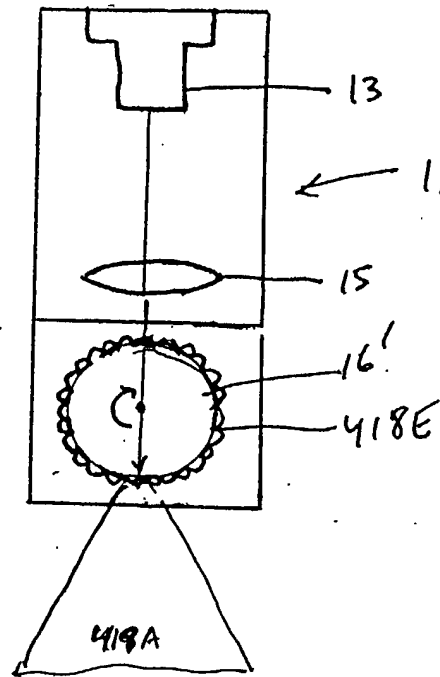


FIG. 1I12C

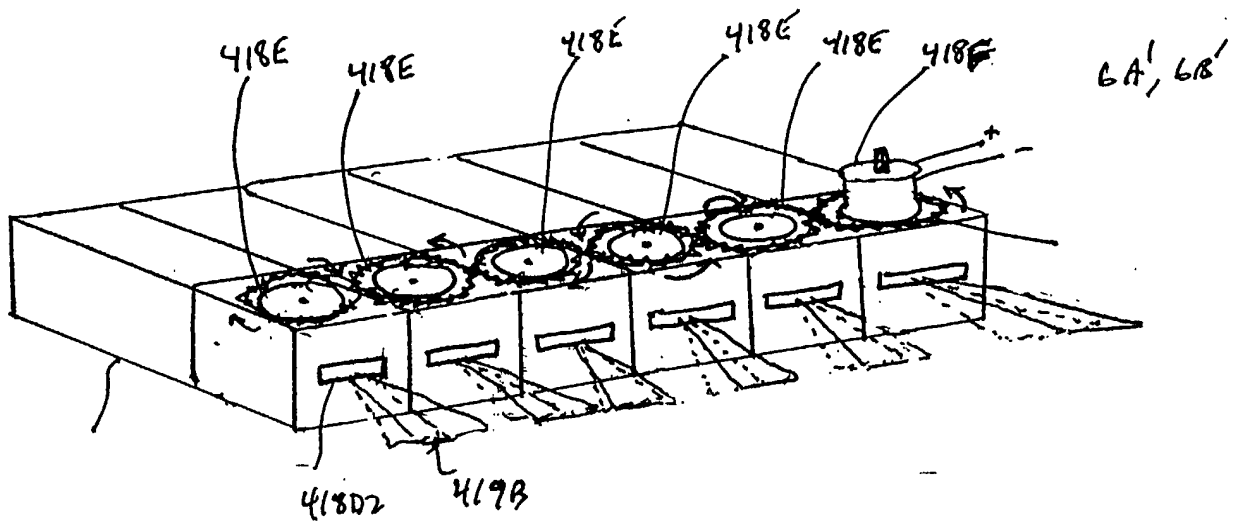


FIG. 1I12D

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Second Generalized Method of  
Reducing Speckle-Noise Patterns  
at Image Detection Array  
of FLD FFD Subsystem (3)

(TIME)

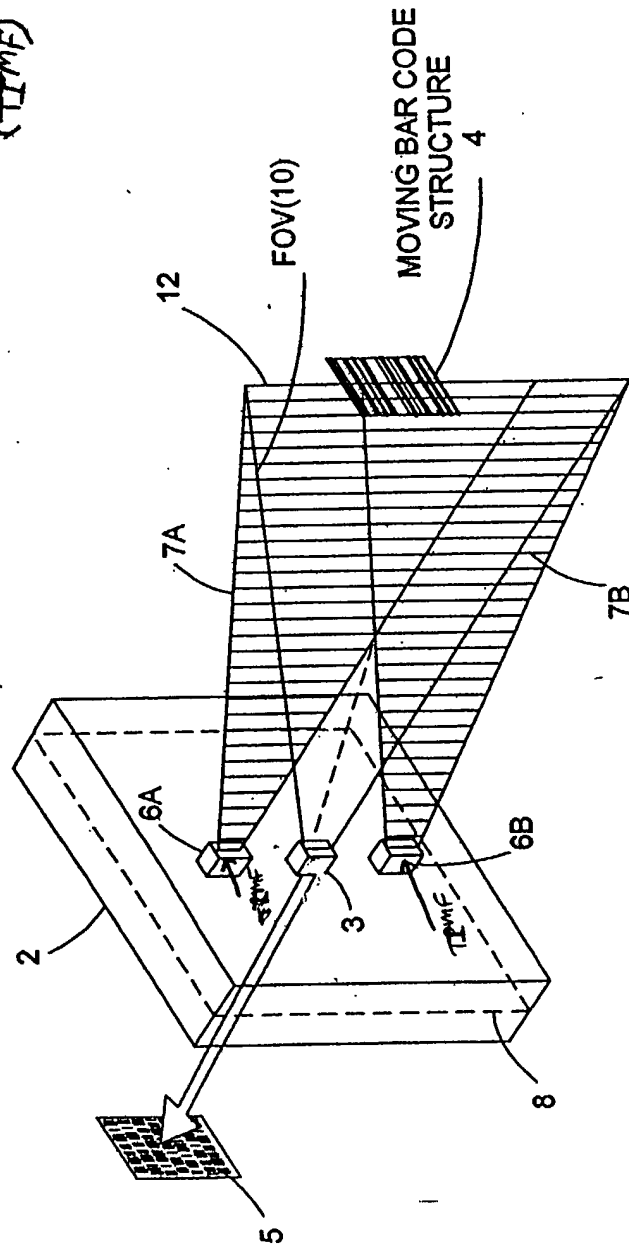


FIG. 1113

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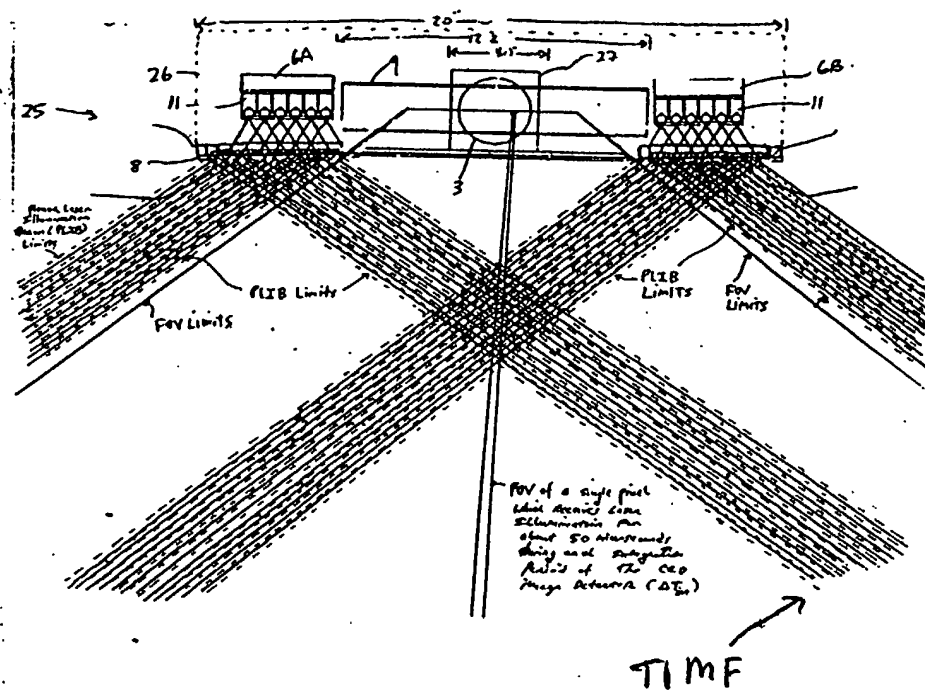


FIG. 1 I 13A

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**The Second Generalized Speckle-Noise Pattern Reduction Method  
Of The Present Invention**

Prior to illumination of the target with the planar laser illumination beam (PLIB), modulate the temporal intensity of the transmitted PLIB along the planar extent thereof according to a temporal intensity modulation function (TIMF) so as to

produce numerous substantially different time-varying speckle-noise patterns at the image detection array of the IFD Subsystem during the photo-integration time period thereof.

Temporally average the numerous substantially different time-varying speckle-noise patterns produced at the image detection array in the IFD Subsystem during the photo-integration time period thereof, so as to thereby reduce power of the speckle-noise pattern observed at the image detection array.

FIG 1I13B



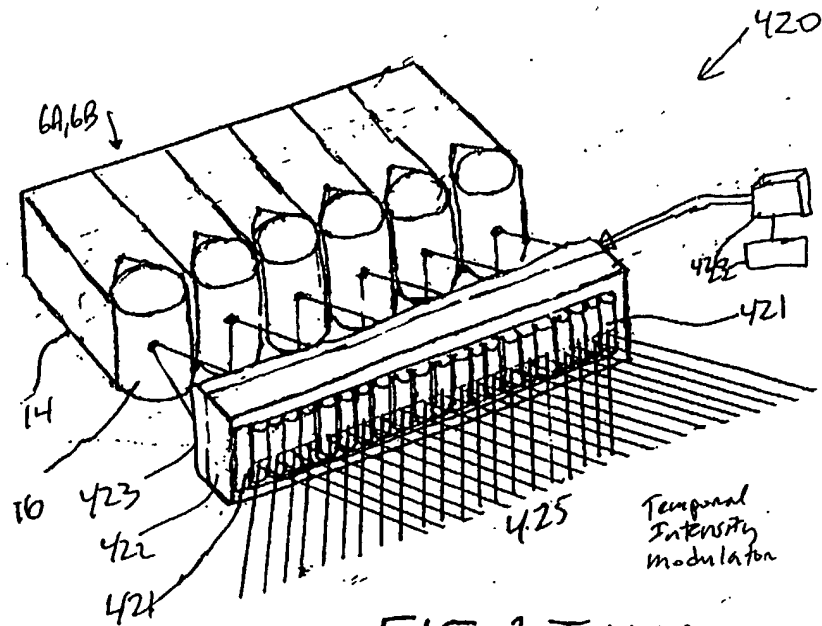


FIG. 1I14A

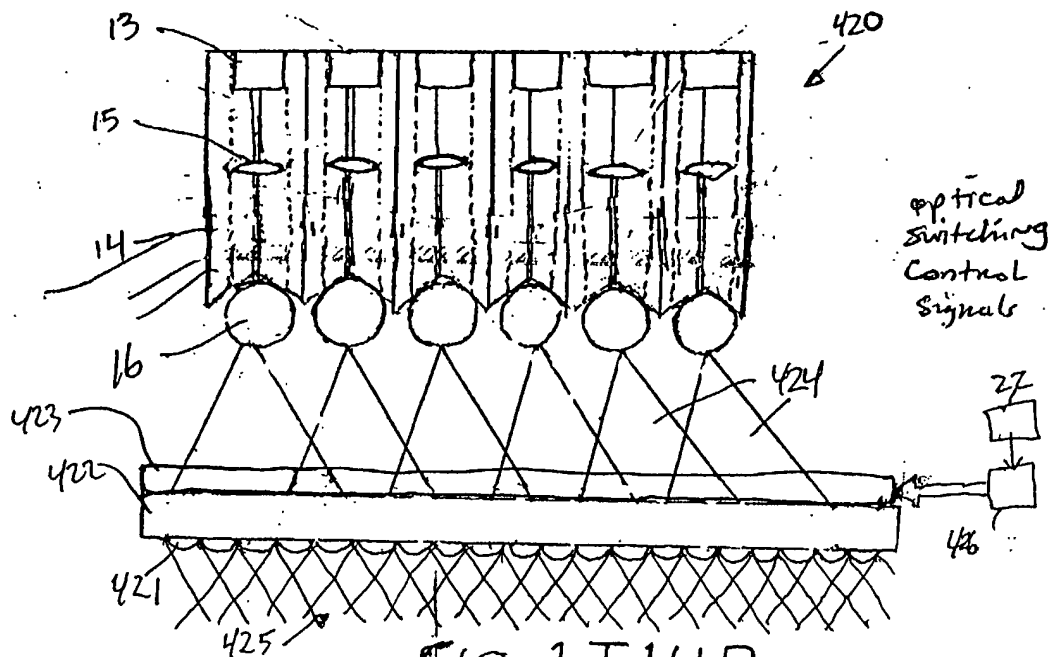
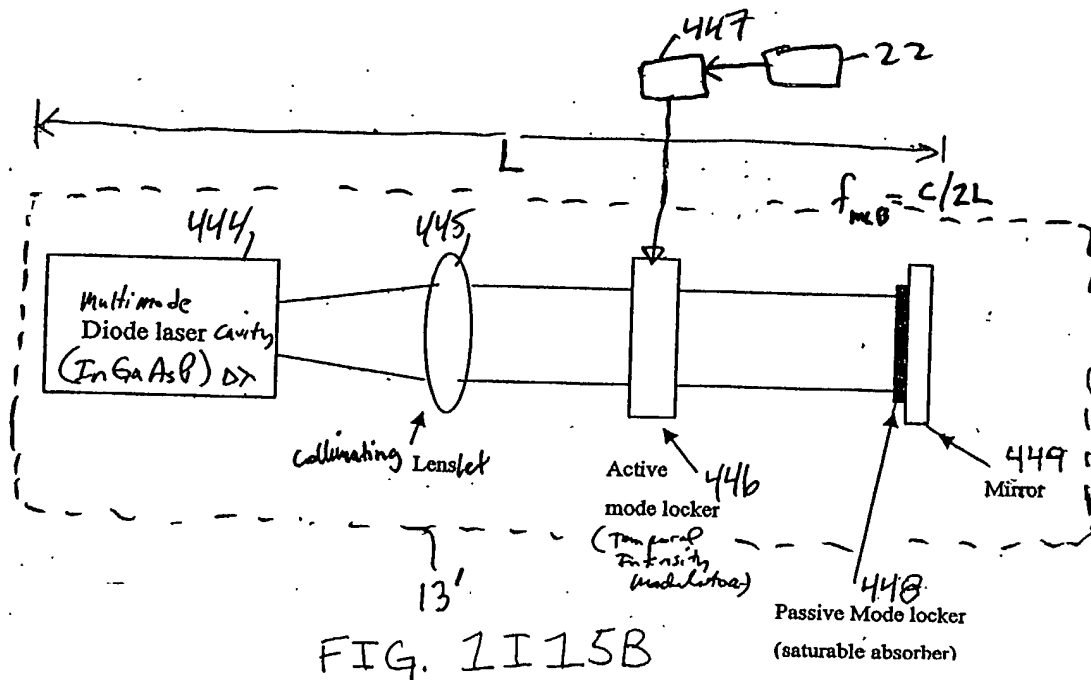
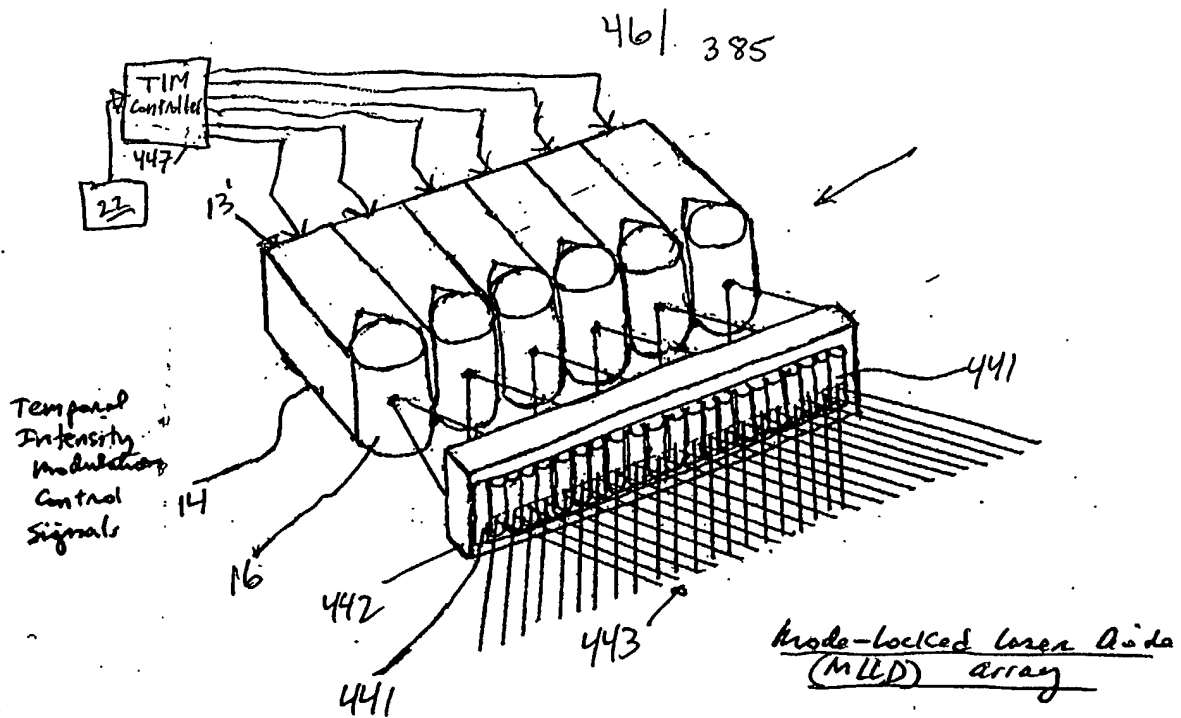
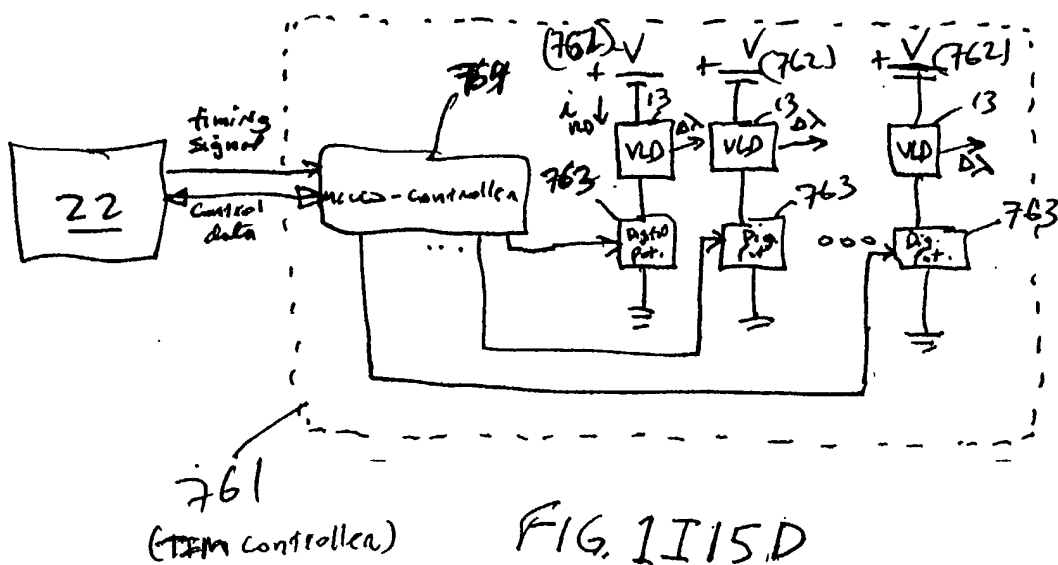
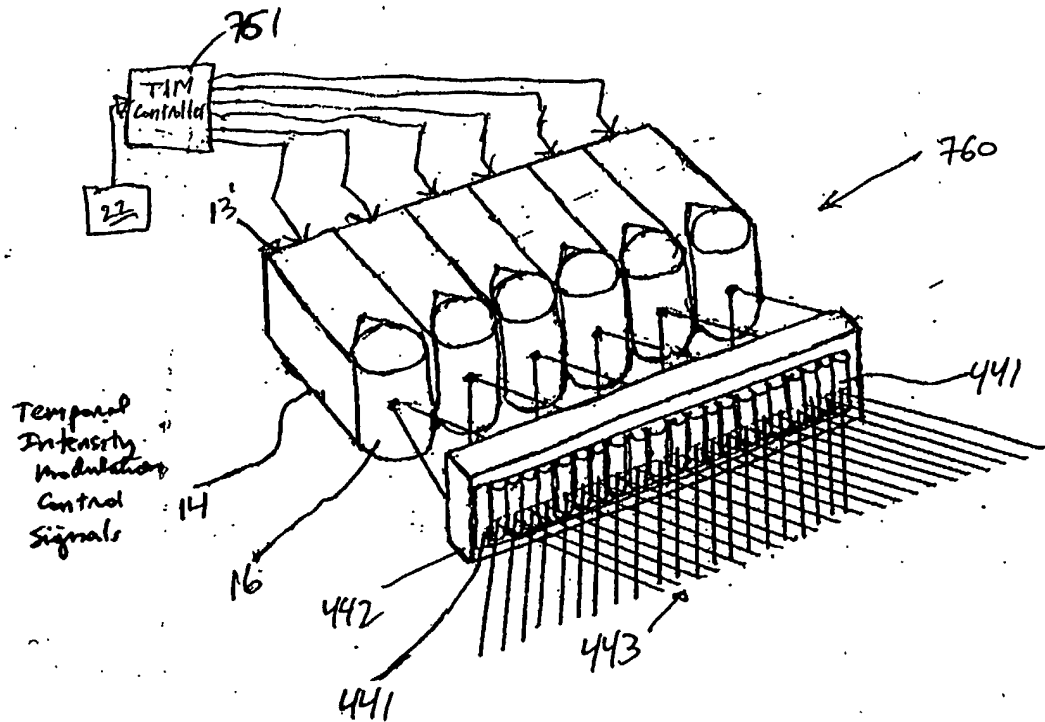


FIG. 1I14B



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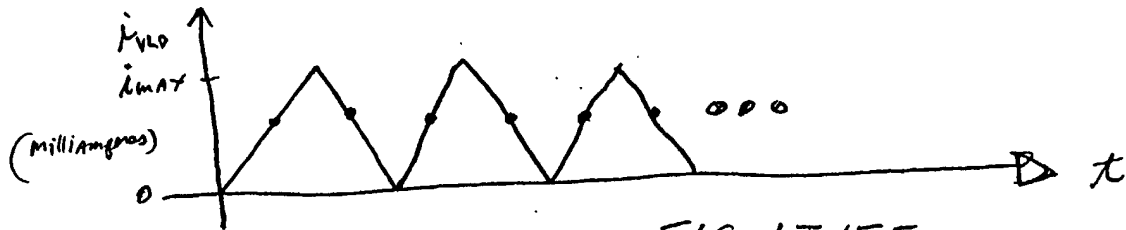


FIG. 1I15E

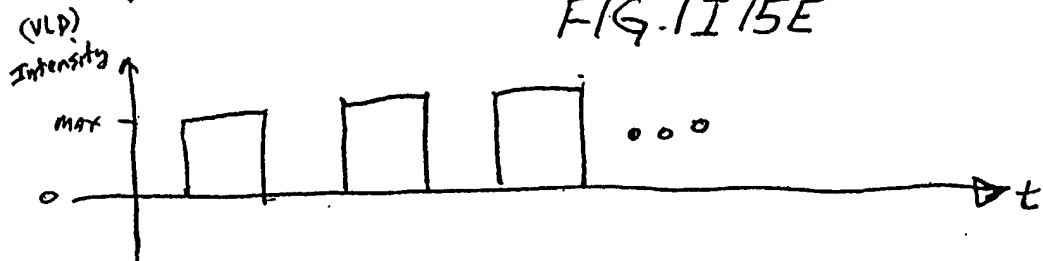


FIG. 1I15E

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Third Generalized Method of  
Reducing Spoke-Nose Patterns  
at Image Detection Array  
of the FFD Subsystem (3)

(TIME)

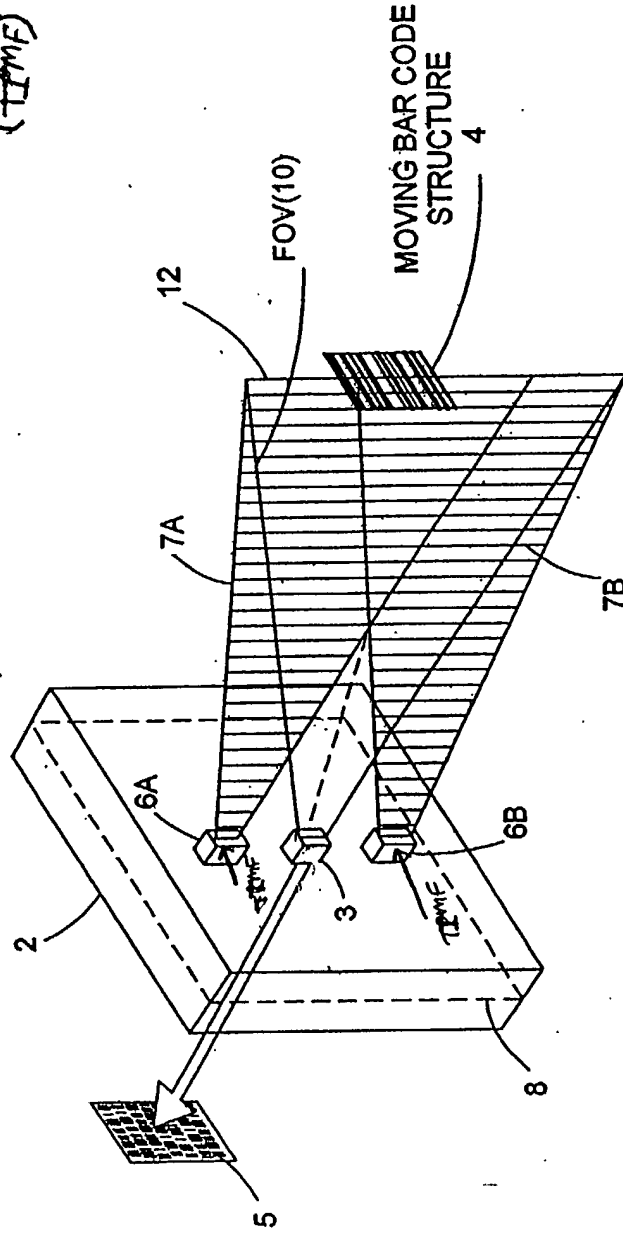


FIG. 1116

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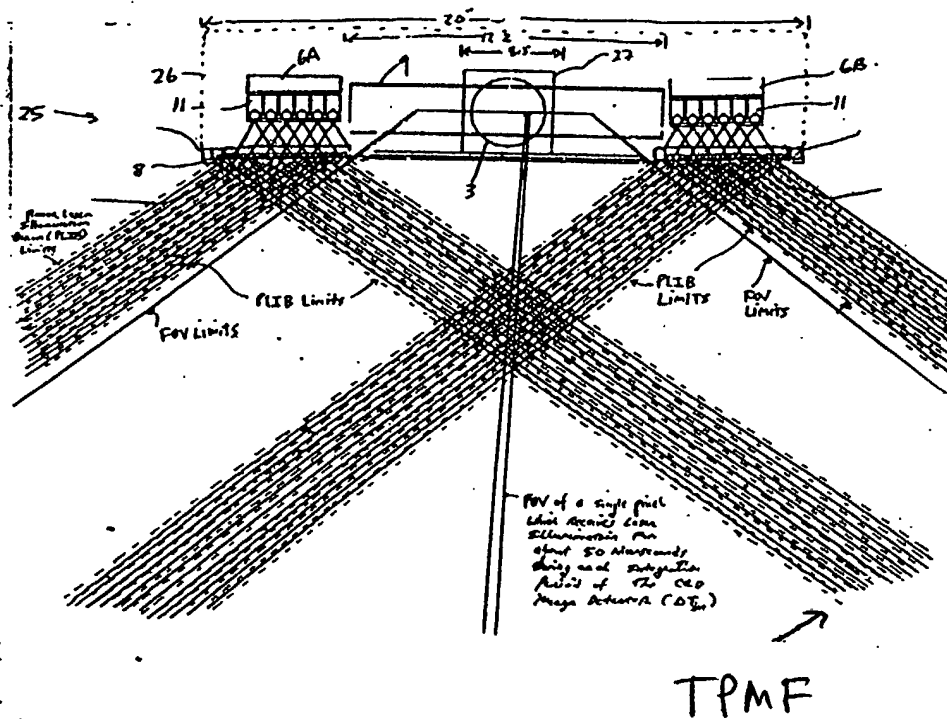


FIG. 1116A

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Third Generalized Speckle-Noise Pattern Reduction Method  
Of The Present Invention

Prior to illumination of the target with the planar laser illumination beam (PLIB), modulate the temporal *phase* of the transmitted PLIB ~~along the planar extent thereof~~ according to a *temporal phase* modulation function (TPMF) so as to:

produce numerous substantially different time-varying speckle-noise patterns at the image detection array of the IFD Subsystem during the photo-integration time period thereof.

↓

Temporally average the numerous substantially different time-varying speckle-noise patterns produced at the image detection array in the IFD Subsystem during the photo-integration time period thereof, so as to thereby reduce power of the speckle-noise pattern observed at the image detection array.

FIG. 1I/6B

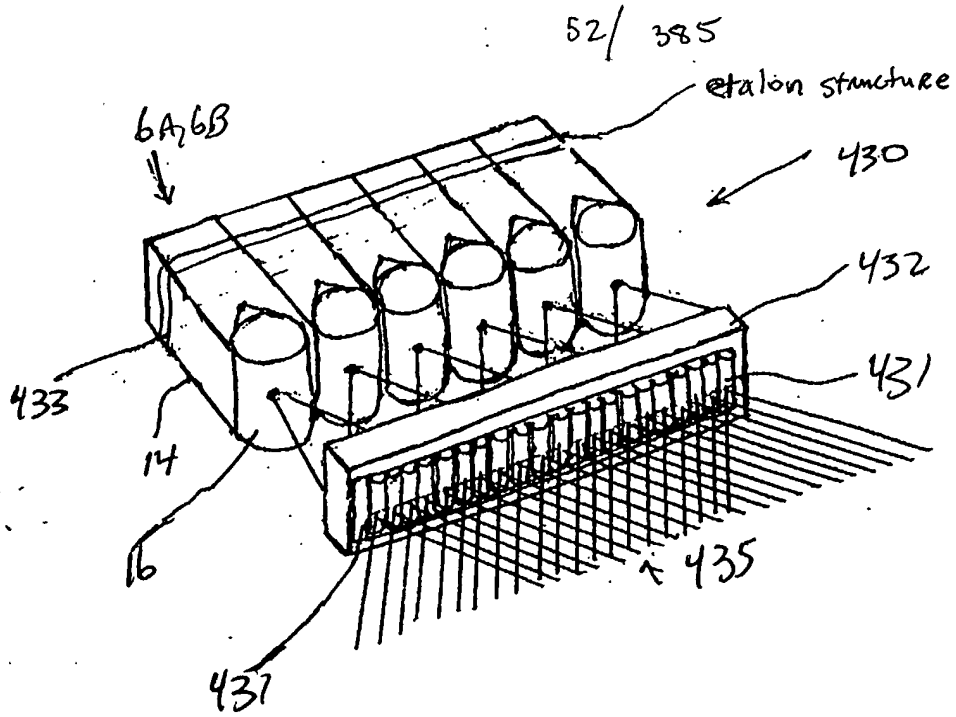


FIG. 1I17A

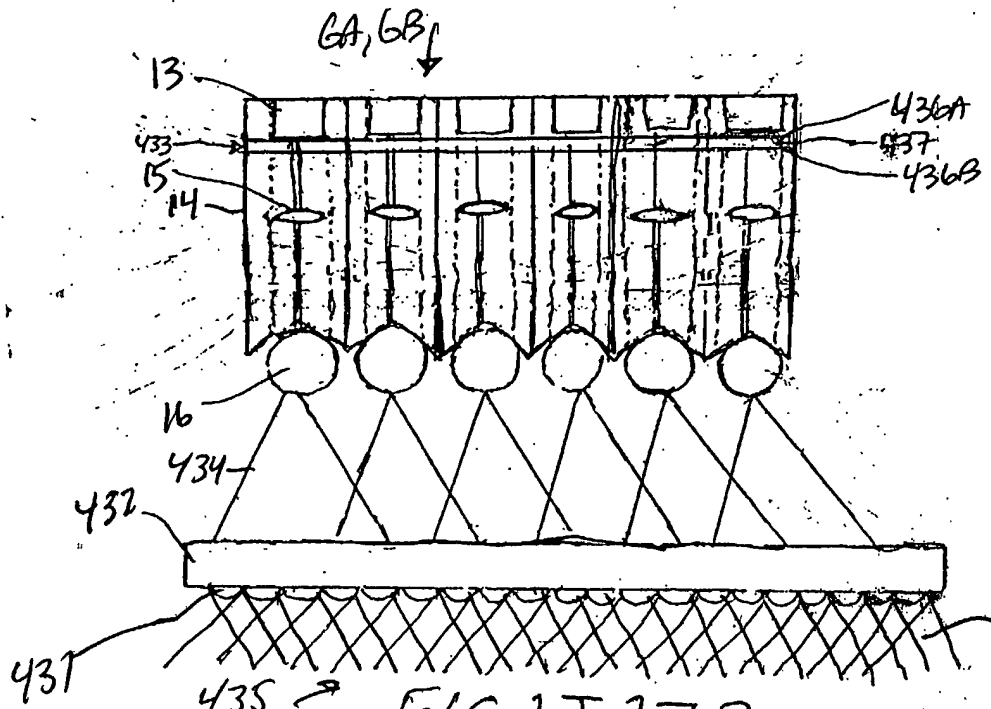


FIG. 1I17B



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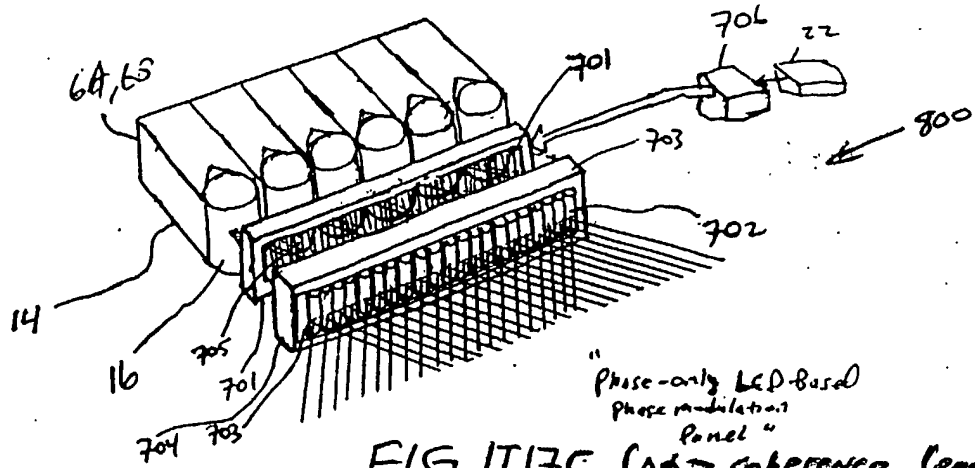


FIG. 1I17C ( $\Delta\phi >$  coherence length  
of VLD)

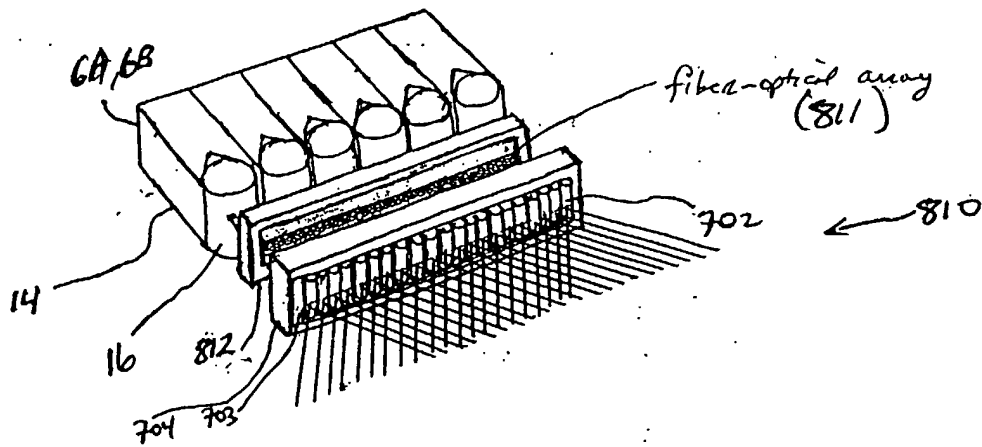


FIG. 1I17D

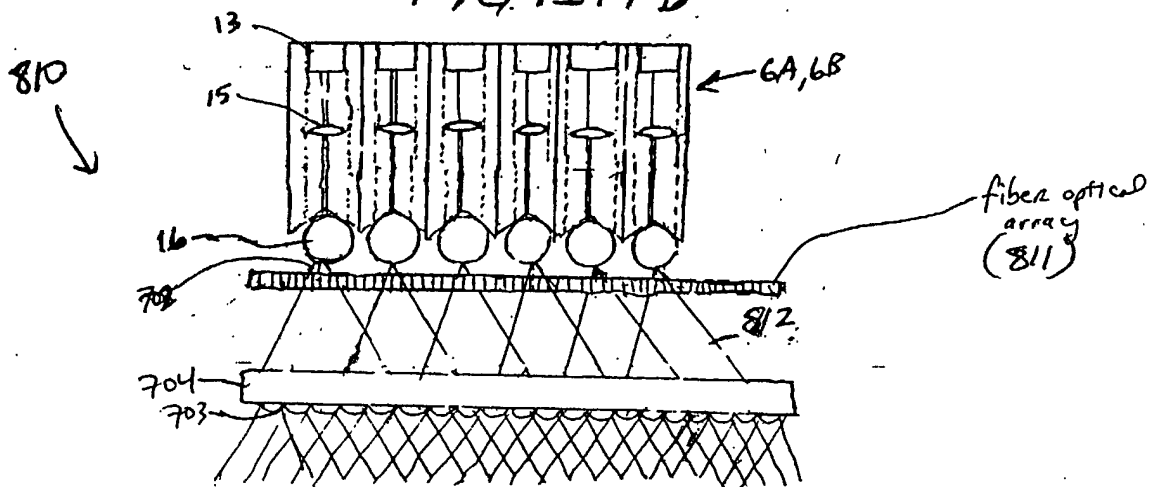


FIG. 1I17E

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Fourth Generalized Method of  
Reducing Spackle-Noise Patterns  
at Image Detection Array  
of the FFD Subsystem (3)

(TFMP)

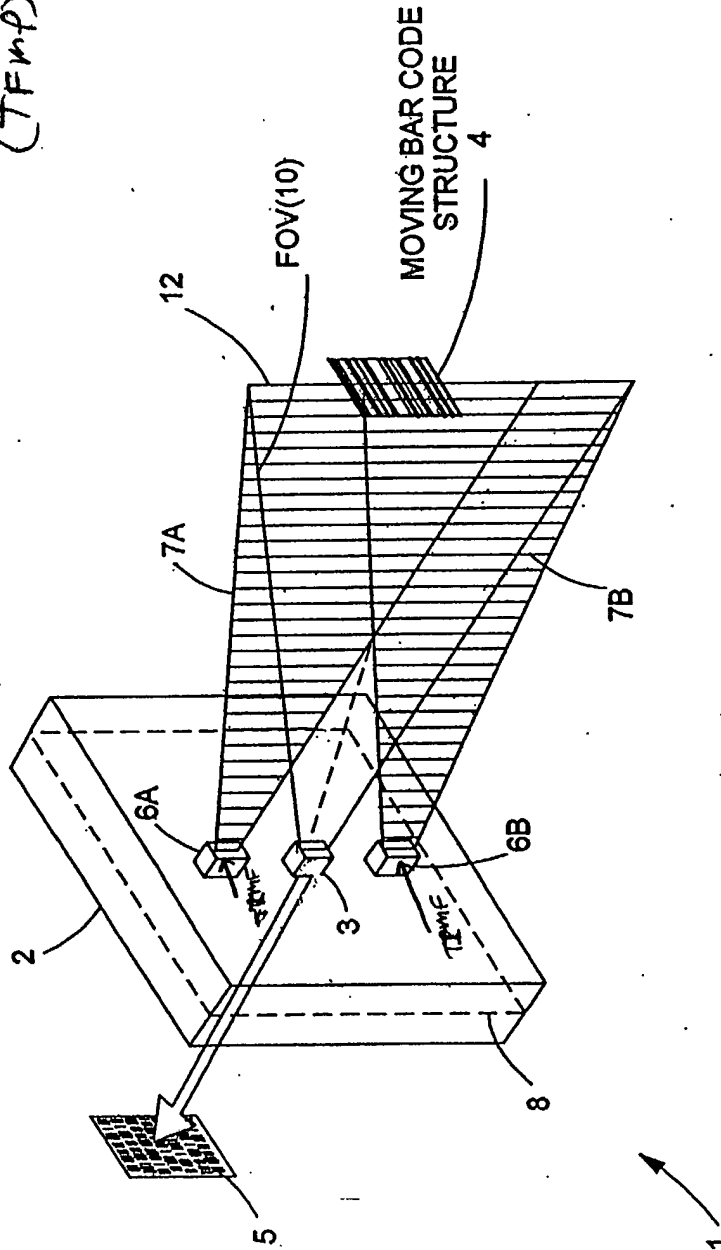


FIG. 1118

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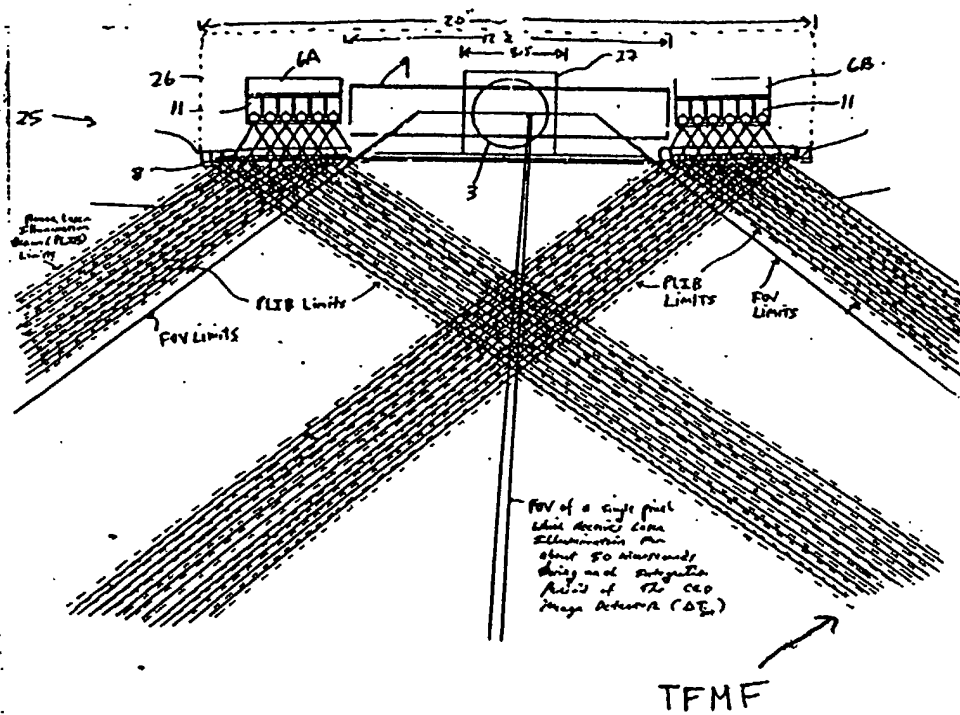


FIG. 1 I 18A

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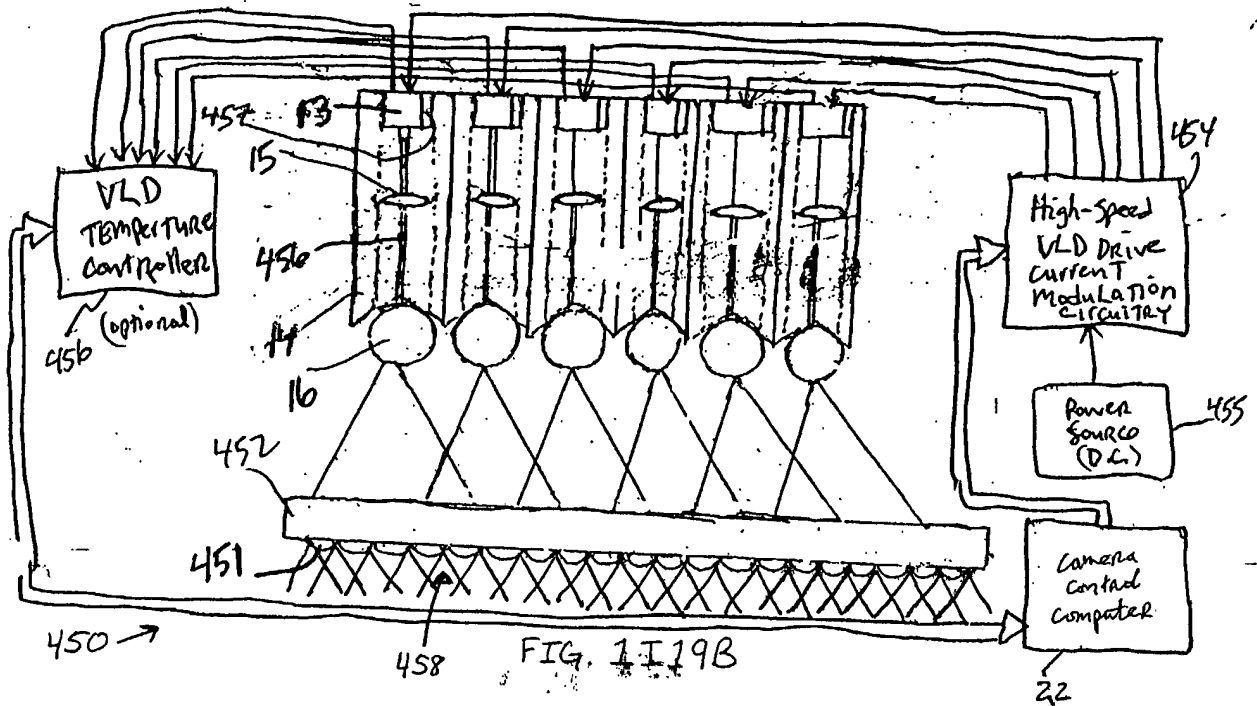
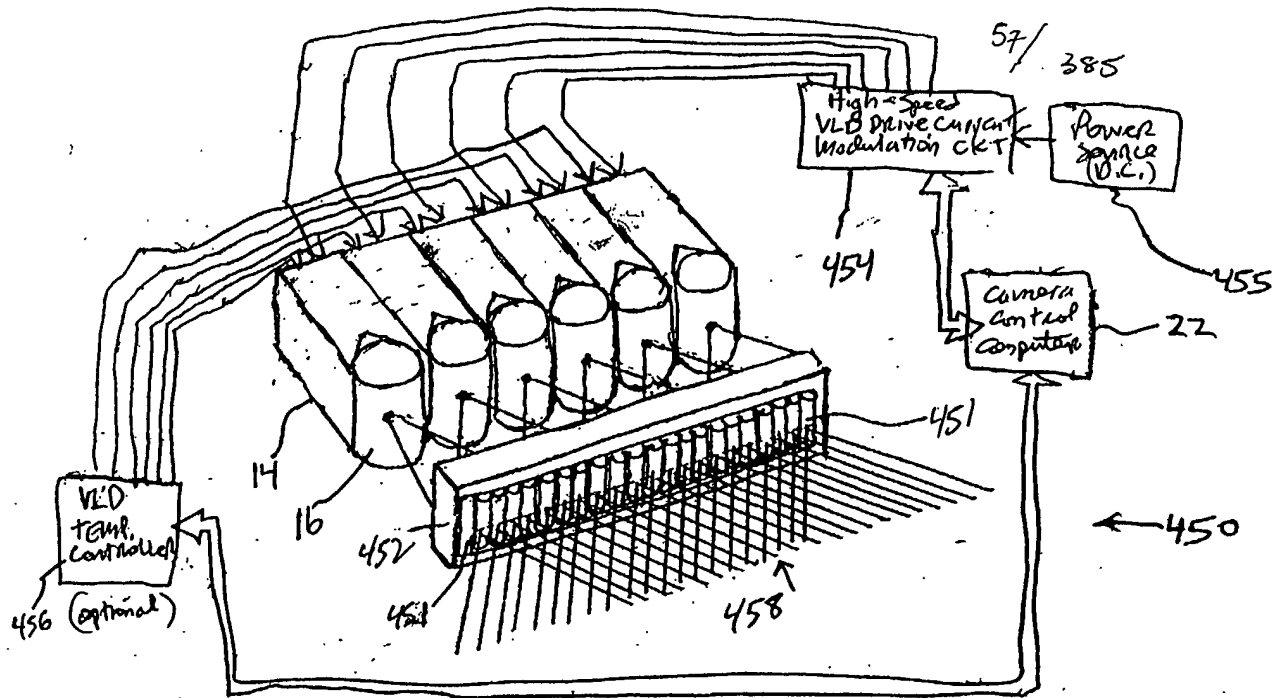
Fourth Generalized Speckle-Noise Pattern Reduction Method  
Of The Present Invention

Prior to illumination of the target with the planar laser illumination beam (PLIB), modulate the temporal frequency of the transmitted PLIB according to a temporal intensity modulation function (T IMF) so as to

produce numerous substantially different time-varying speckle-noise patterns at the image detection array of the IFD Subsystem during the photo-integration time period thereof.

Temporally average the numerous substantially different time-varying speckle-noise patterns produced at the image detection array in the IFD Subsystem during the photo-integration time period thereof, so as to thereby reduce power of the speckle-noise pattern observed at the image detection array.

FIG. 1118B



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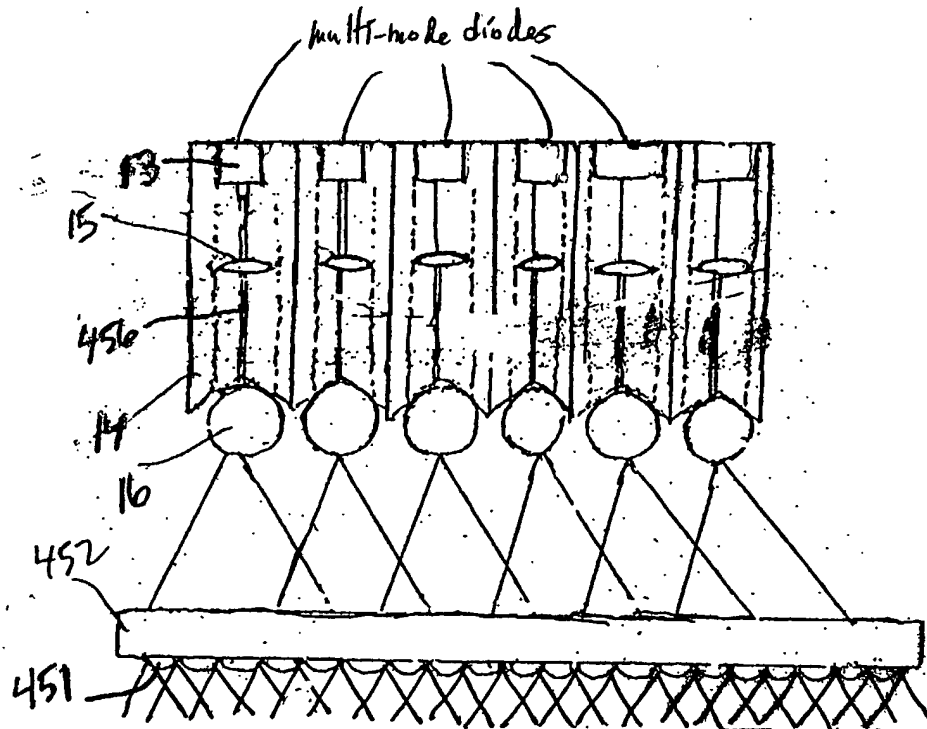


FIG 1I19C

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Fifth Generalized Method  
of Reducing Speckle-Noise  
Patterns At Image  
Detection array of the  
IPD subsystem (3)

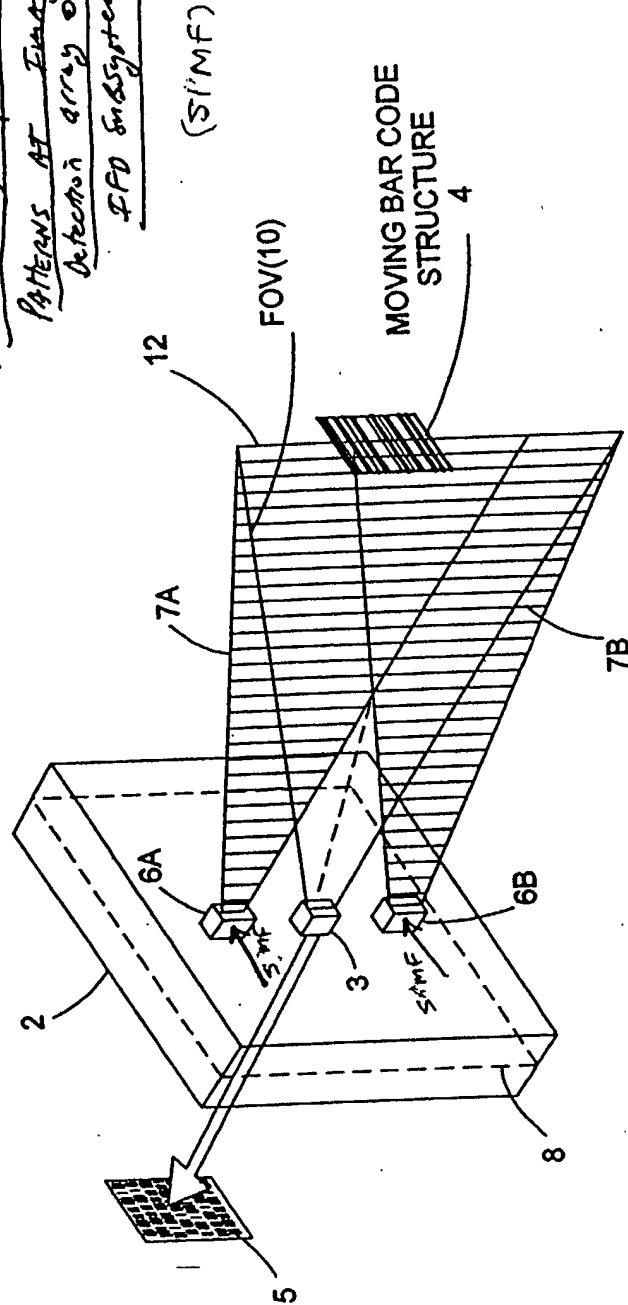
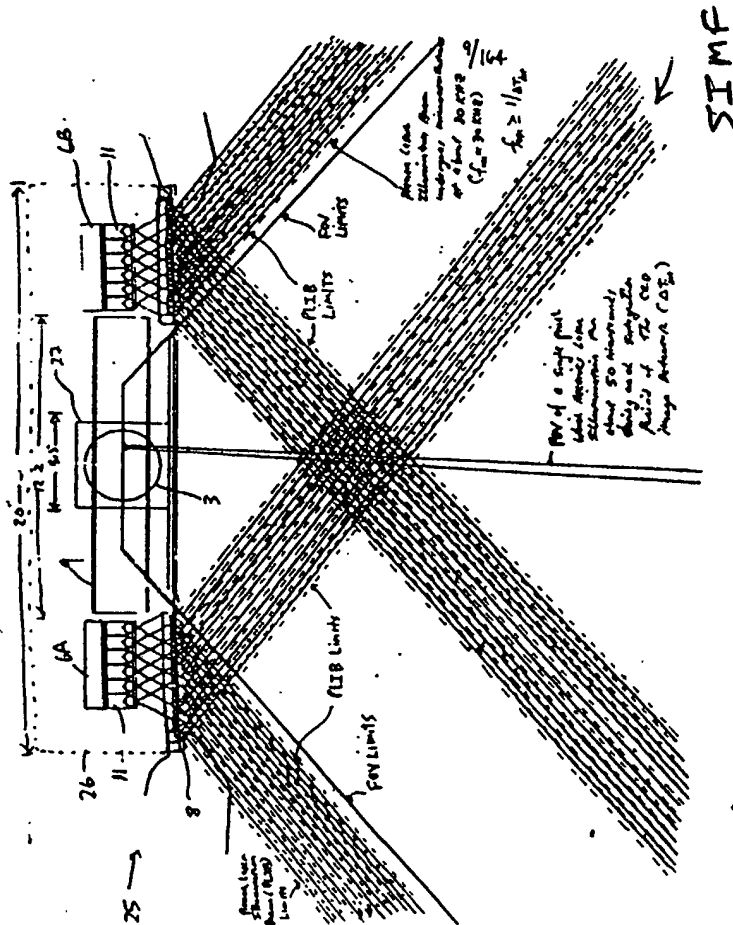


FIG 1F 20

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Prior to object illumination



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Fifth Generalized Speckle-Noise Pattern Reduction Method  
Of The Present Invention

Prior to illumination of the target with the planar laser illumination beam (PLIB), modulate the spatial intensity of the transmitted PLIB along the planar extent thereof according to a spatial intensity modulation function (SIMF) so as to

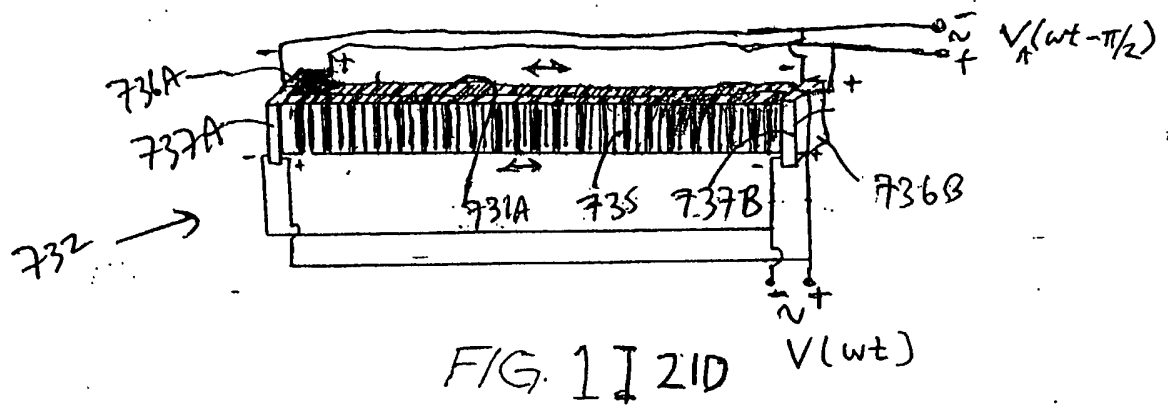
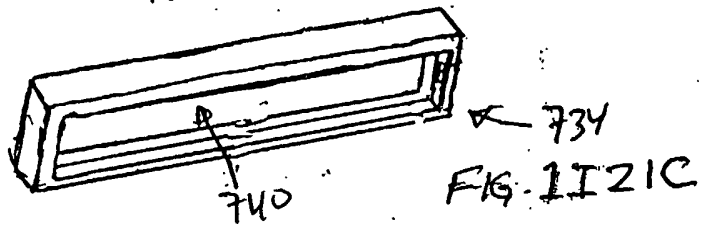
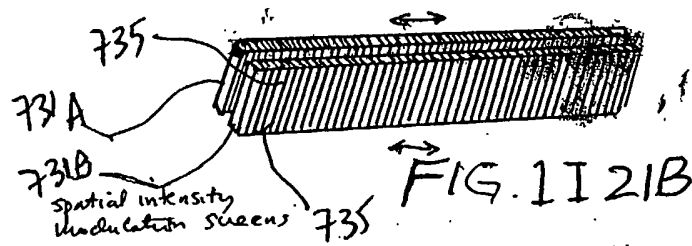
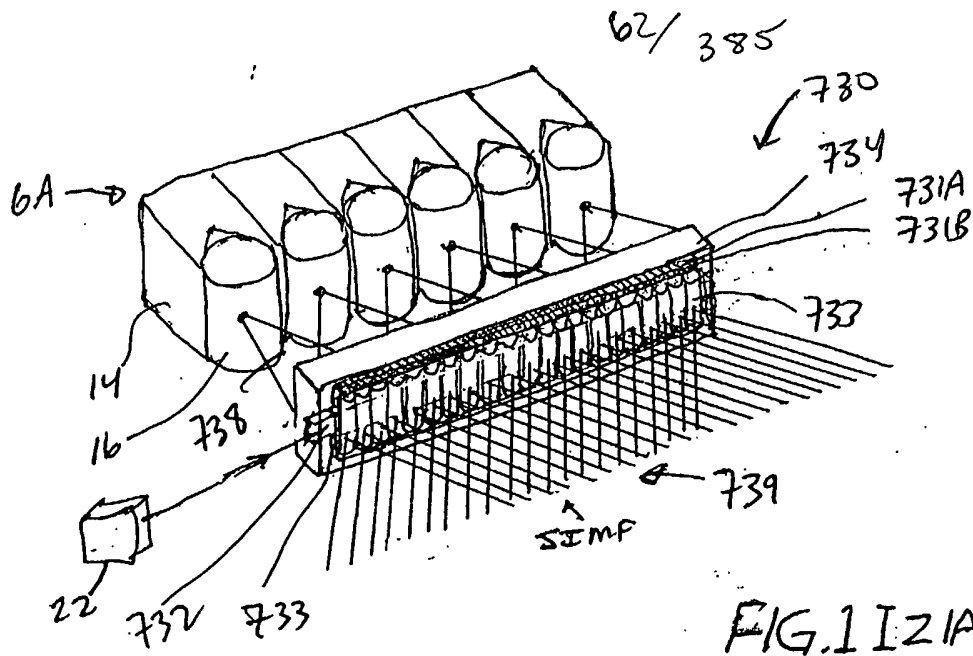
produce numerous substantially different time-varying speckle-noise patterns at the image detection array of the IFD Subsystem during the photo-integration time period thereof.

A

Temporally average the numerous substantially different time-varying speckle-noise patterns produced at the image detection array in the IFD Subsystem during the photo-integration time period thereof, so as to thereby reduce power of the speckle-noise pattern observed at the image detection array.

B

FIG. 1I20B



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Generalized Method of  
Reducing Speckle-Noise Patterns  
at Image Detection array  
of the IFD Subsystem

(SIMF)

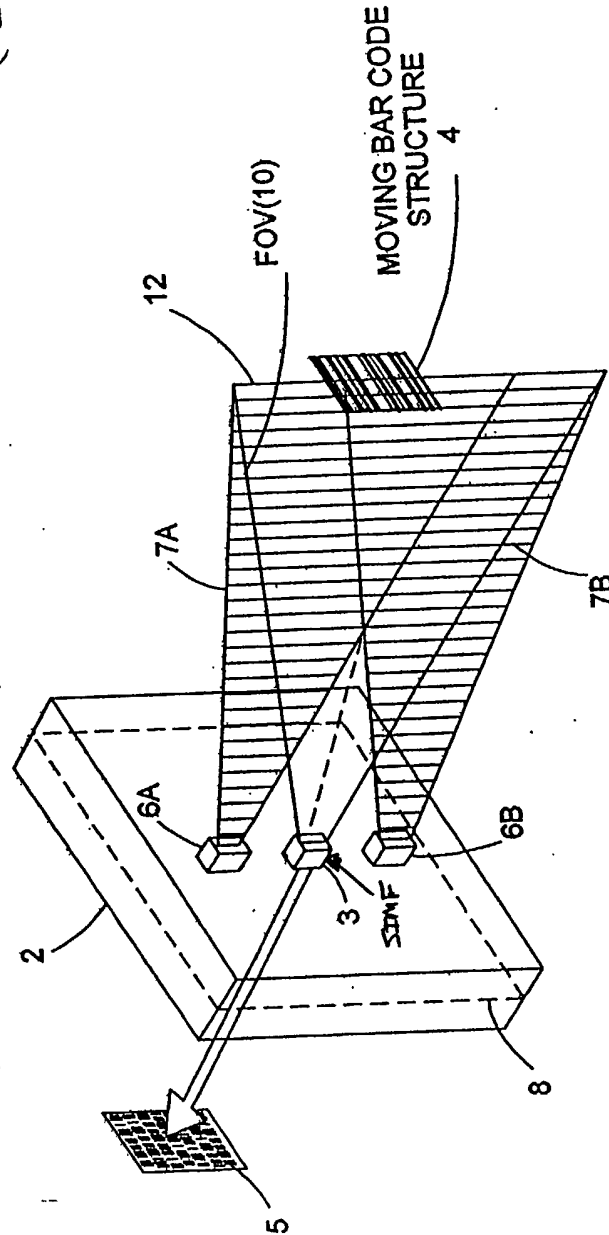


FIG. 11 22

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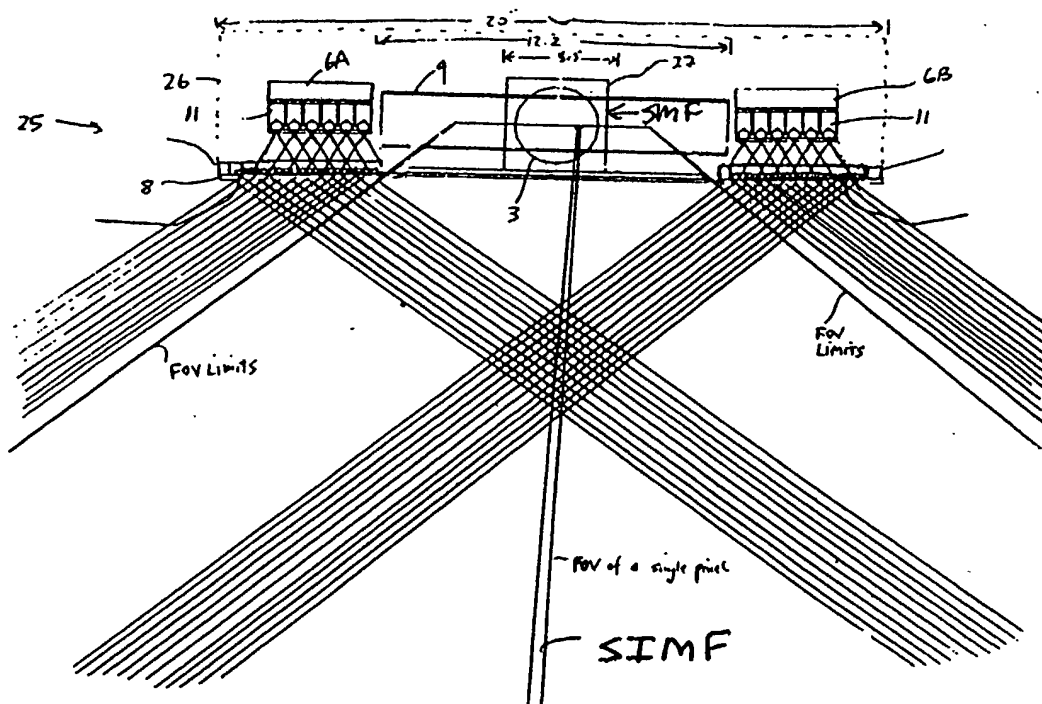


FIG. II 22A

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Sixth Generalized Speckle-Noise Pattern Reduction Method  
Of The Present Invention

After illumination of the target with the planar laser illumination beam (PLIB), modulate the spatial intensity of the reflected/scattered (i.e. received) PLIB along the planar extent thereof according to a spatial intensity modulation function (SIMF) so as to :

produce numerous substantially different time-varying speckle-noise patterns at the image detection array of the IFD Subsystem during the photo-integration time period thereof.

Temporally average the many substantially different time-varying speckle-noise patterns produced at the image detection array in the IFD Subsystem during the photo-integration time period thereof, so as to thereby reduce the speckle-noise pattern observed at the image detection array.

FIG. 1I 22B

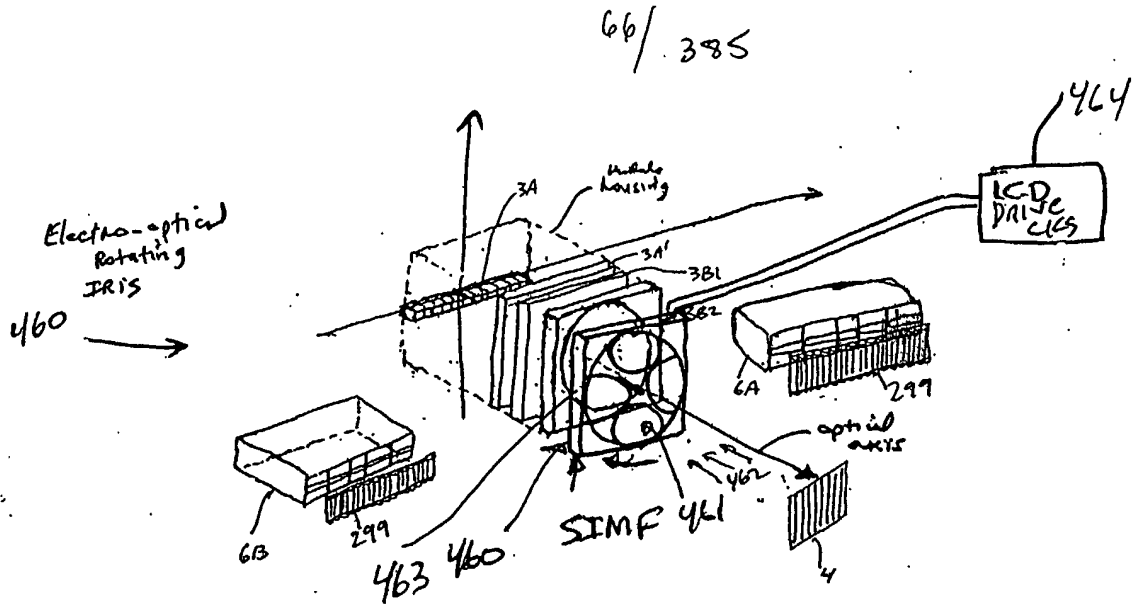


FIG. 1I 23A

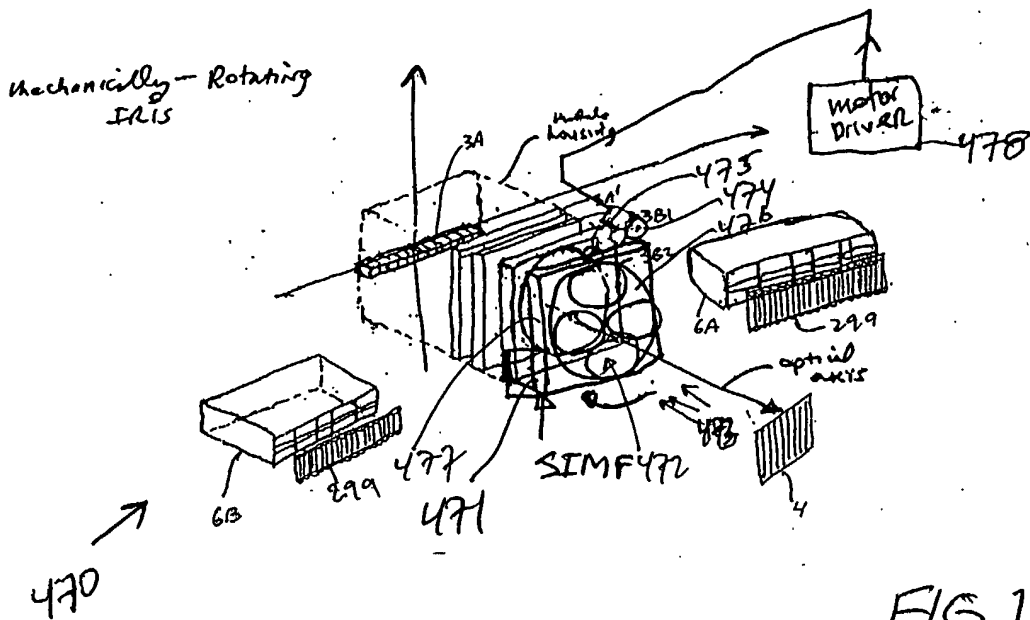


FIG. 1I 23B



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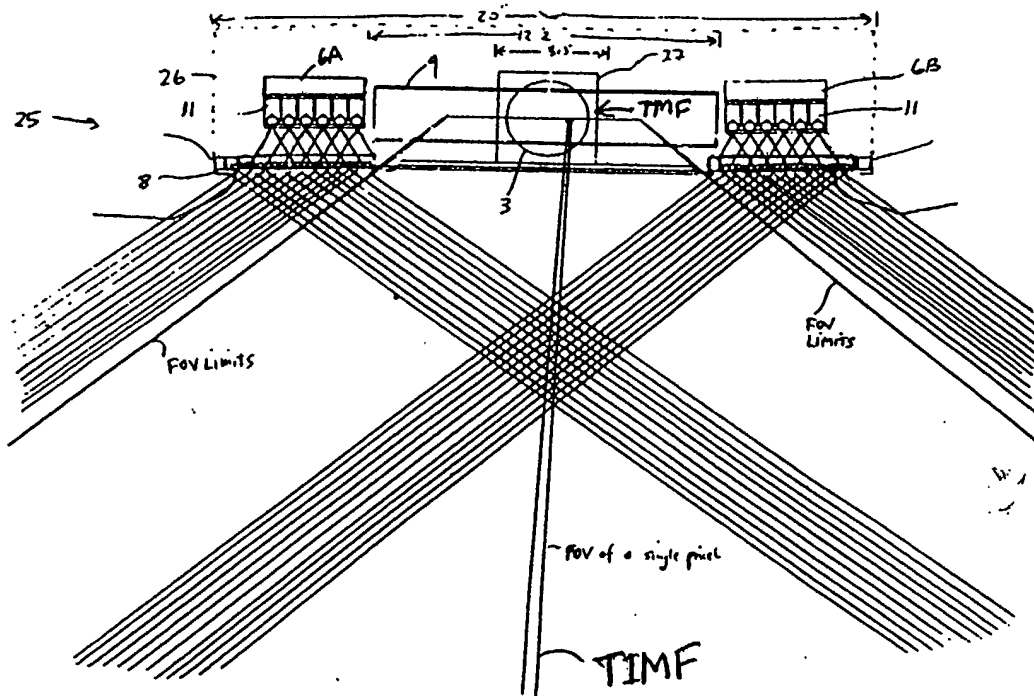


FIG. 1I24A



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Seventh Generalized Speckle-Noise Pattern Reduction Method  
Of The Present Invention

After illumination of the target with the planar laser illumination beam (PLIB), modulate the temporal intensity of the reflected/scattered (i.e. received) PLIB along the planar extent thereof according to a temporal intensity modulation function (TIMF) so as to .

produce many substantially different time-varying speckle-noise patterns at the image detection array of the IFD Subsystem during the photo-integration time period thereof.

Temporally average the many substantially different time-varying speckle-noise patterns produced at the image detection array in the IFD Subsystem during the photo-integration time period thereof, so as to thereby reduce the speckle-noise pattern observed at the image detection array.

FIG. 1I 24B

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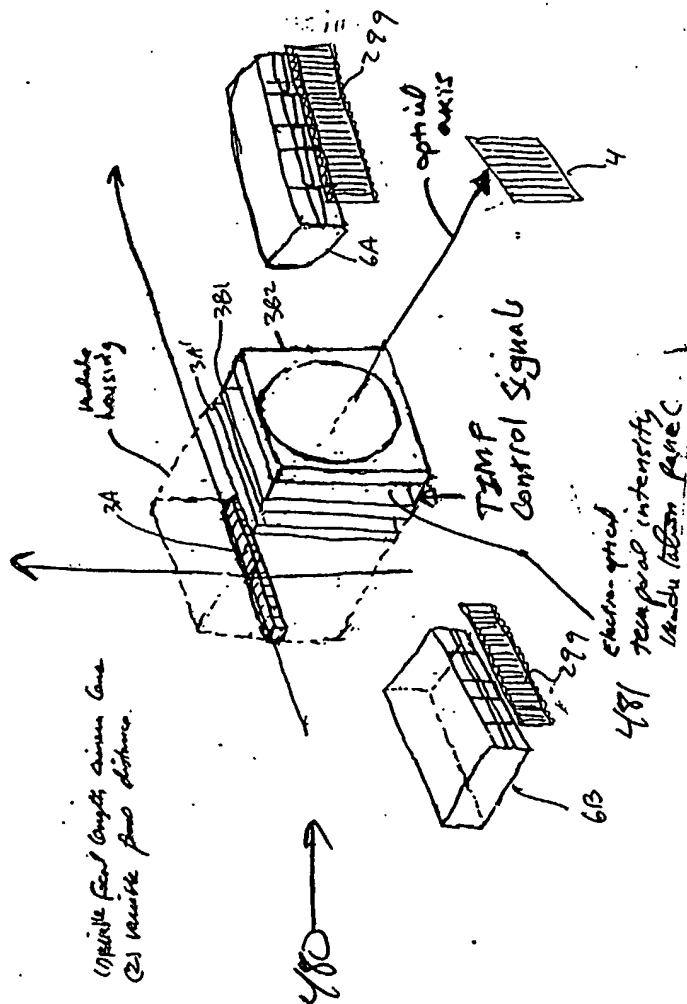


FIG. 11Z4C

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EIGHT GENERALIZED METHOD OF REDUCING THE SPECKLE PATTERN  
NOISE OBSERVED IN PLIIM-BASED IMAGING SYSTEMS

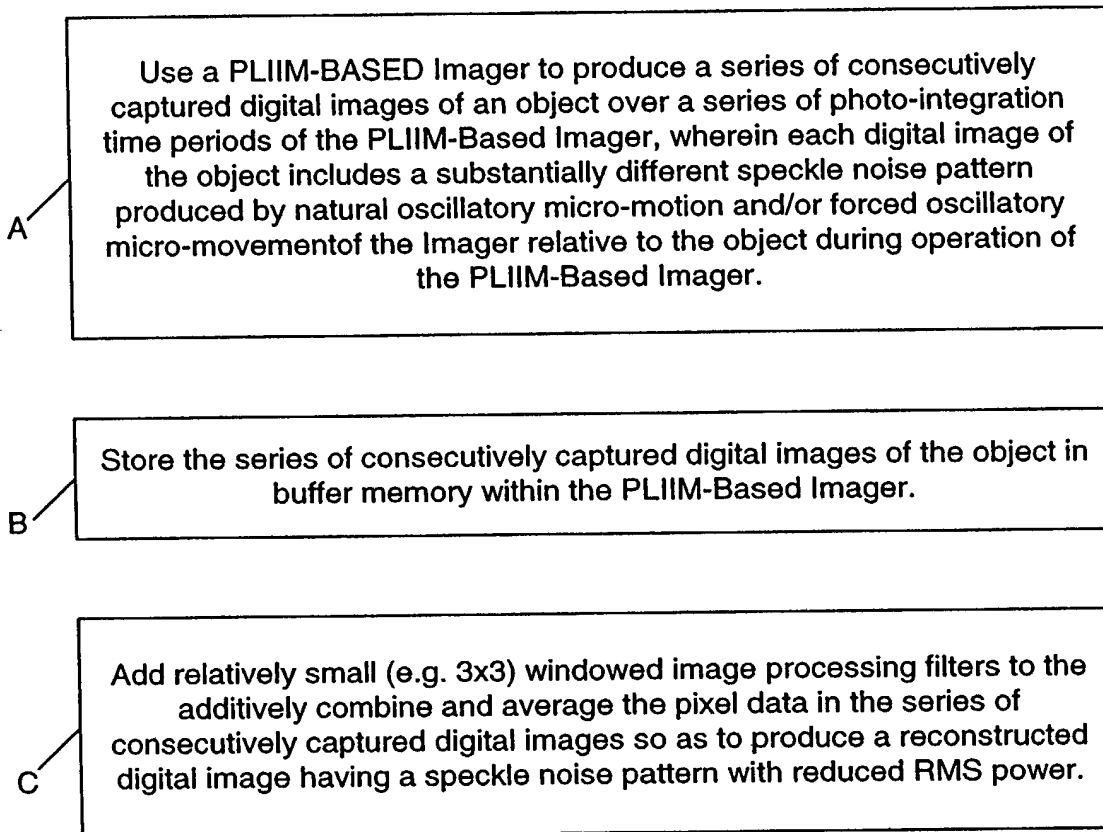


FIG. 1124D

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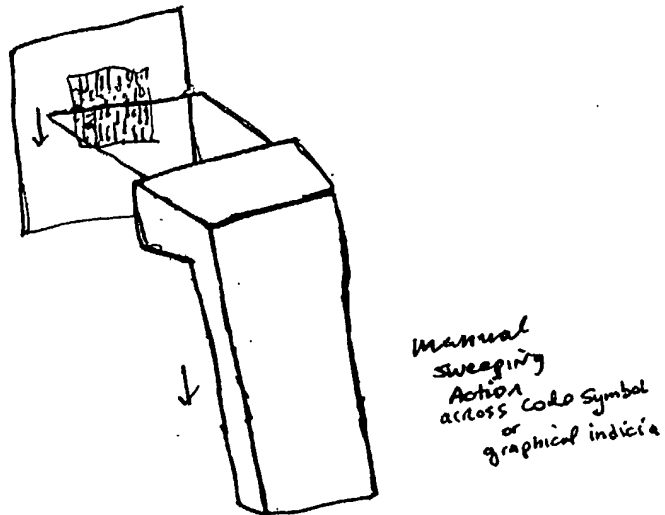
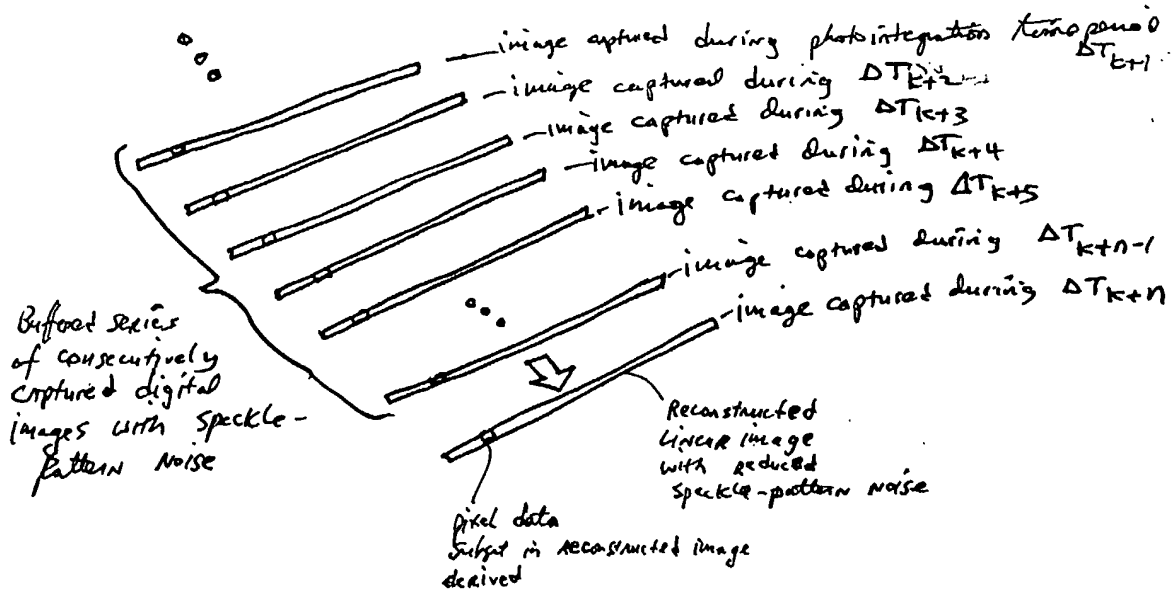


FIG. 1124E



Case: Linear image

FIG. 1124F

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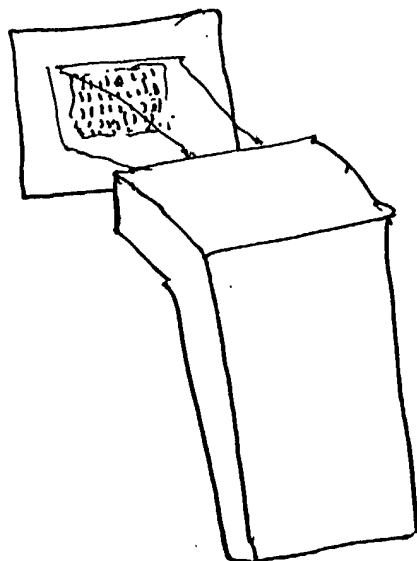


FIG. 1I24G

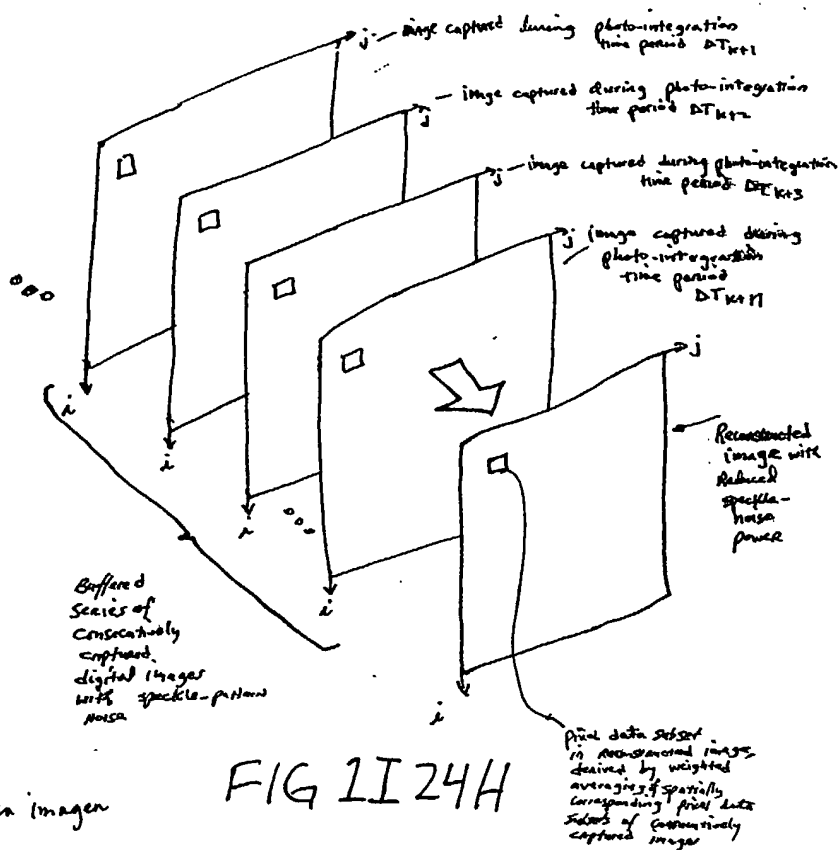


FIG 1I24H

Case: 2D Area Imager

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NINTH GENERALIZED METHOD OF REDUCING SPECKLE PATTERN  
NOISE IN PLIM-BASED IMAGING SYSTEMS

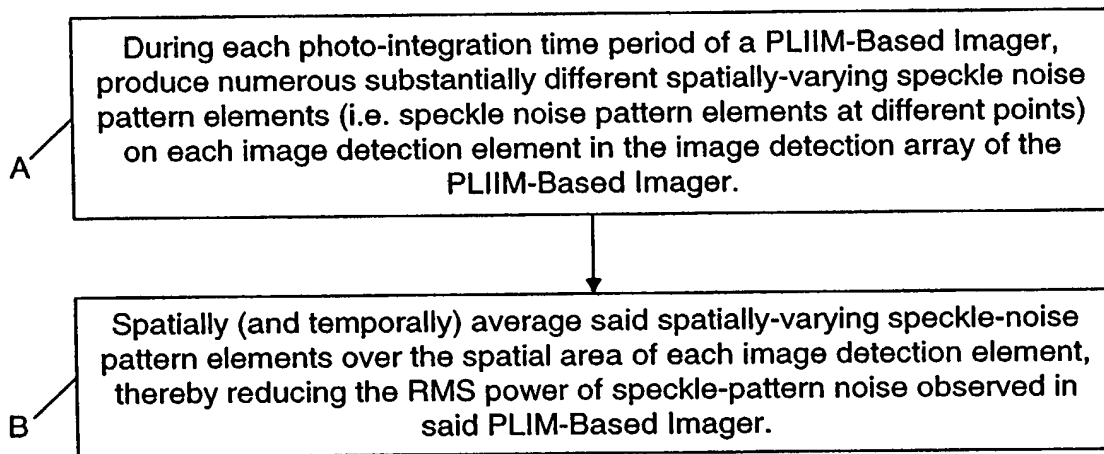
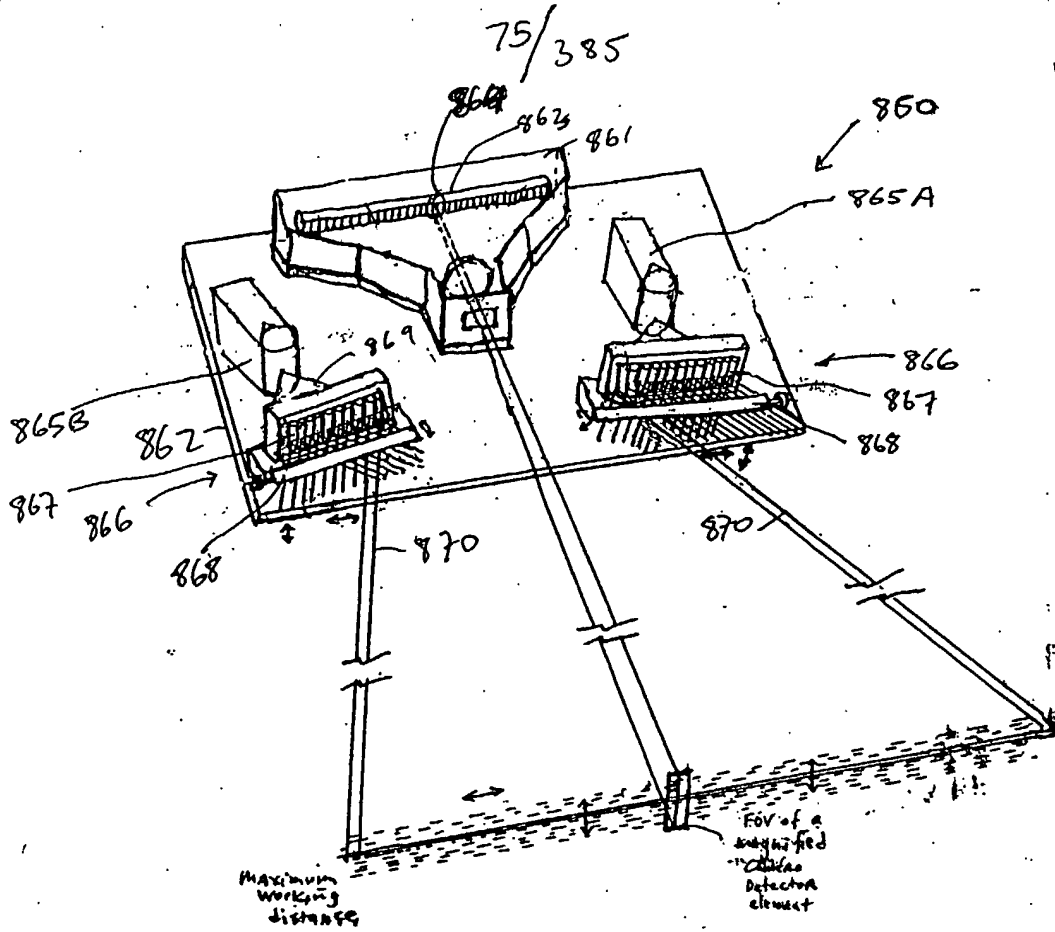


FIG. 1124I



\* Lateral and Transverse Misalignment of PLIB

FIG. 1I25A1

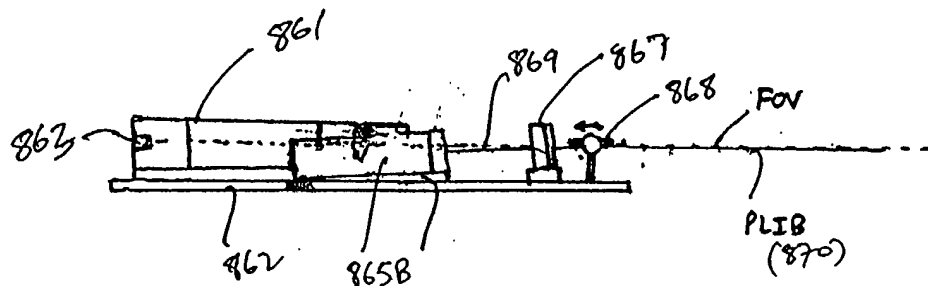


FIG. 1I25A2

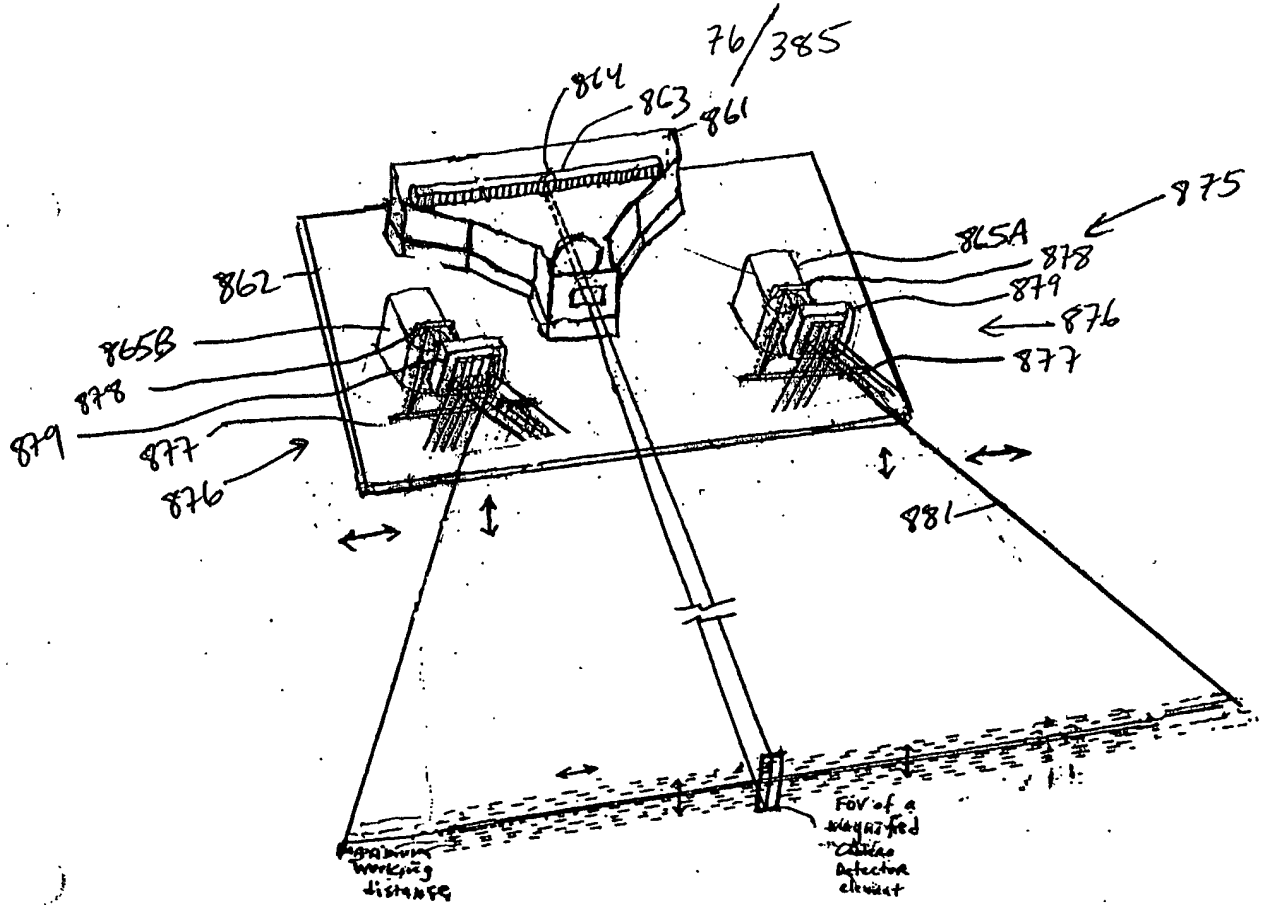


FIG. 1I25B1

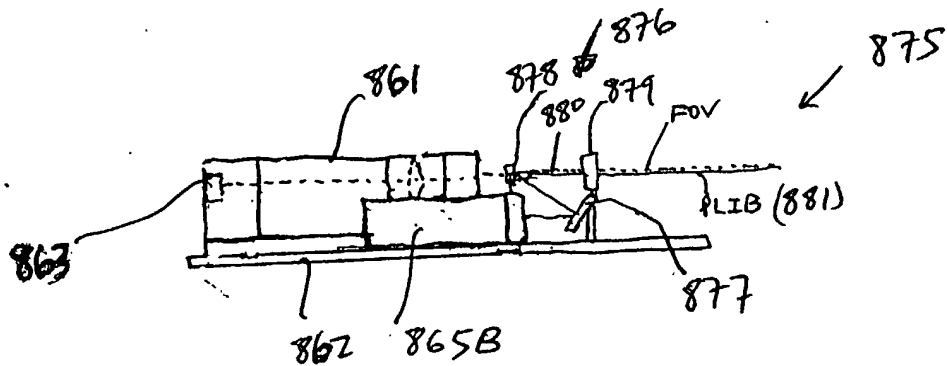
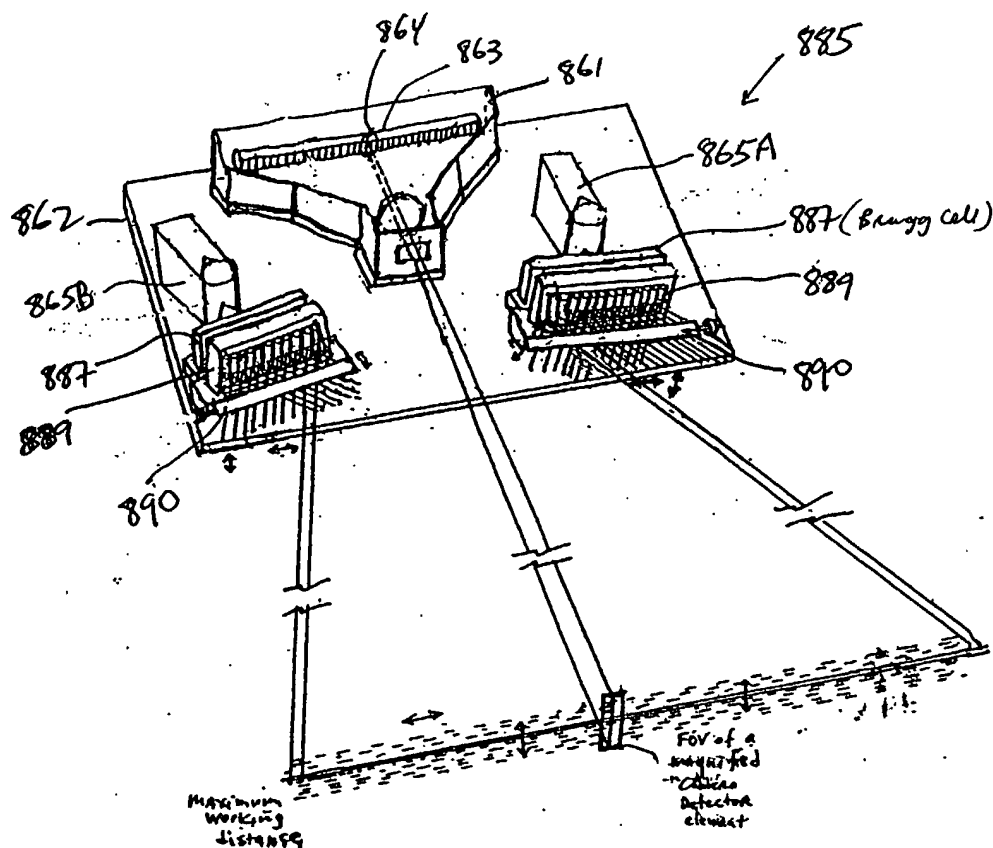


FIG. 1I25B2



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\* Lateral and Transverse Misalignment of PLIB

FIG. 1I25C1

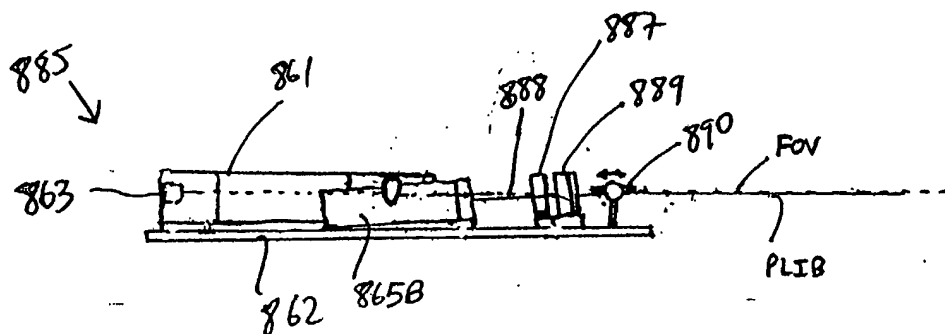
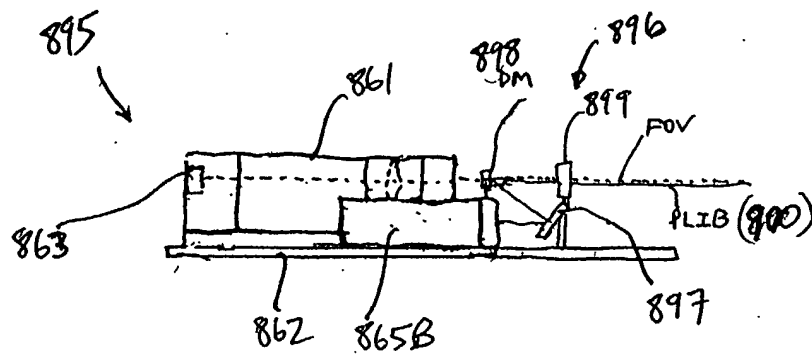
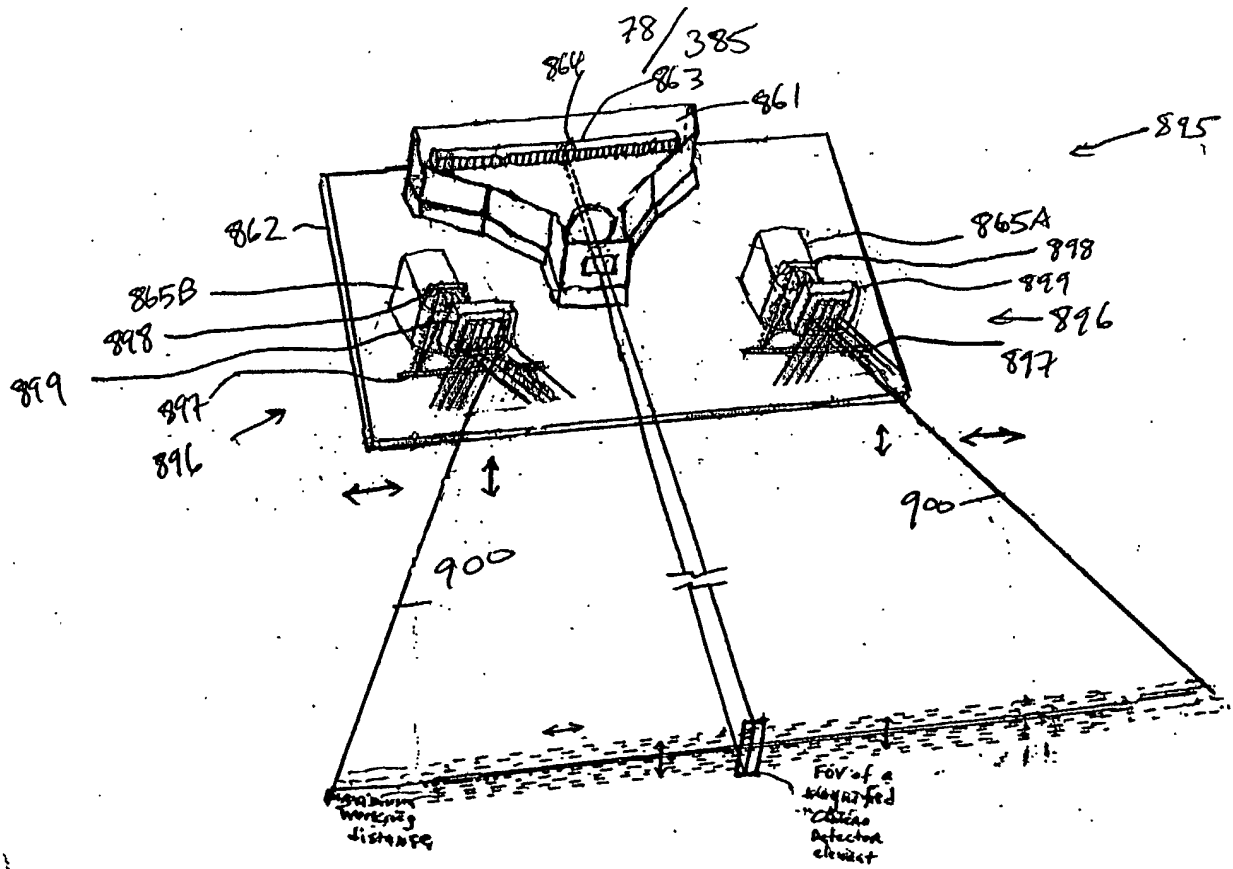
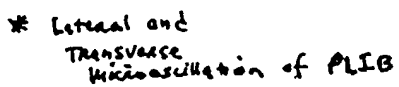


FIG. 1I25C2





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FIG. 1I25E1

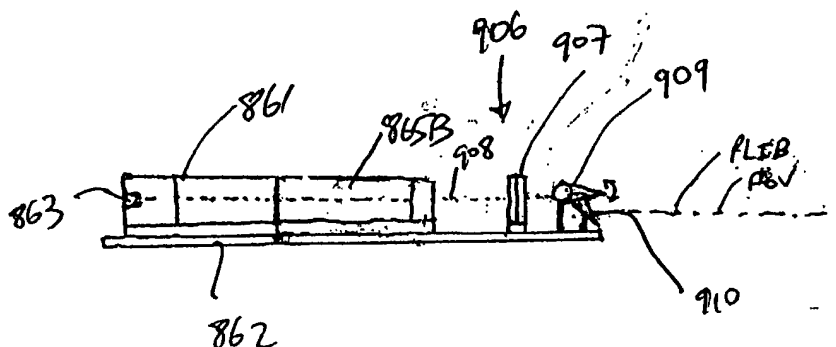
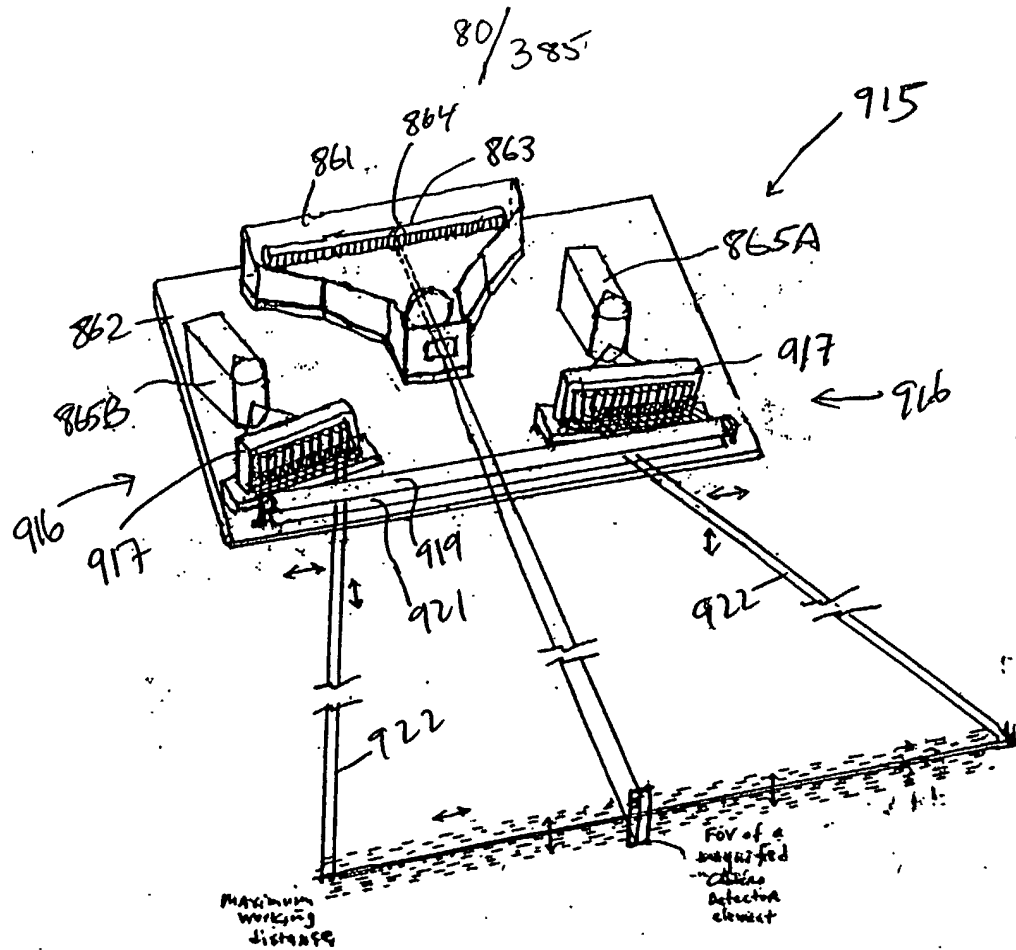


FIG. 1I25E2



\* Lateral and Transverse Misalignment of PLIB

FIG. 1I25F1

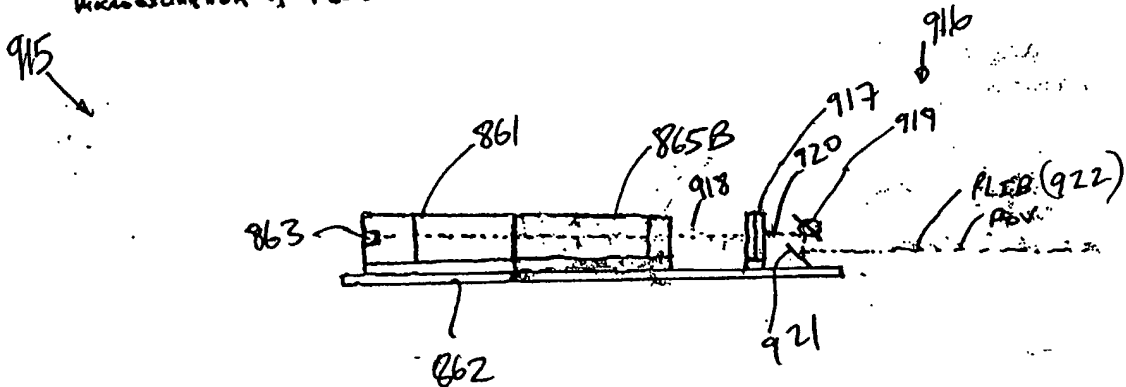
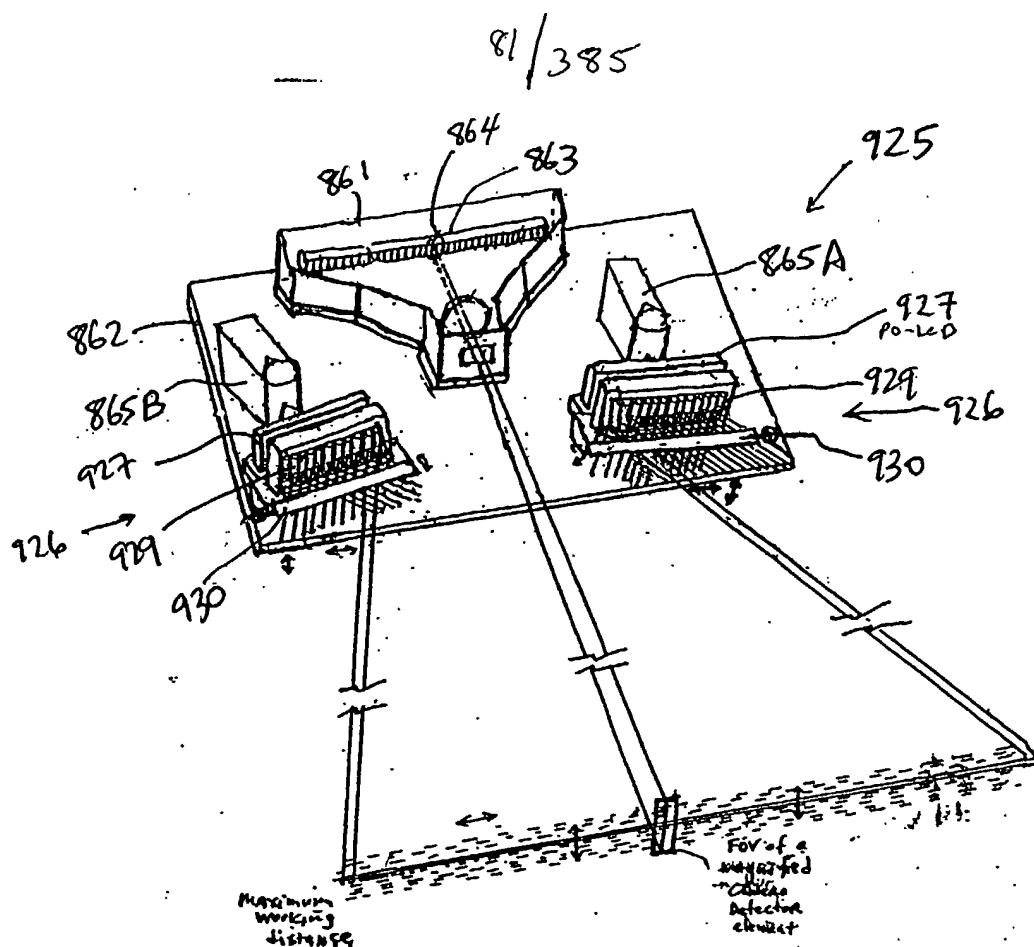


FIG. 1I25F2



\* Lateral and Transverse Microoscillation of PLIB

FIG. 1I25G1

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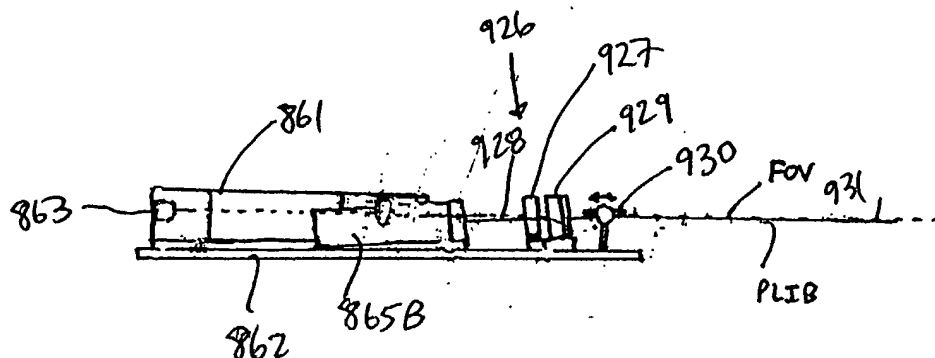
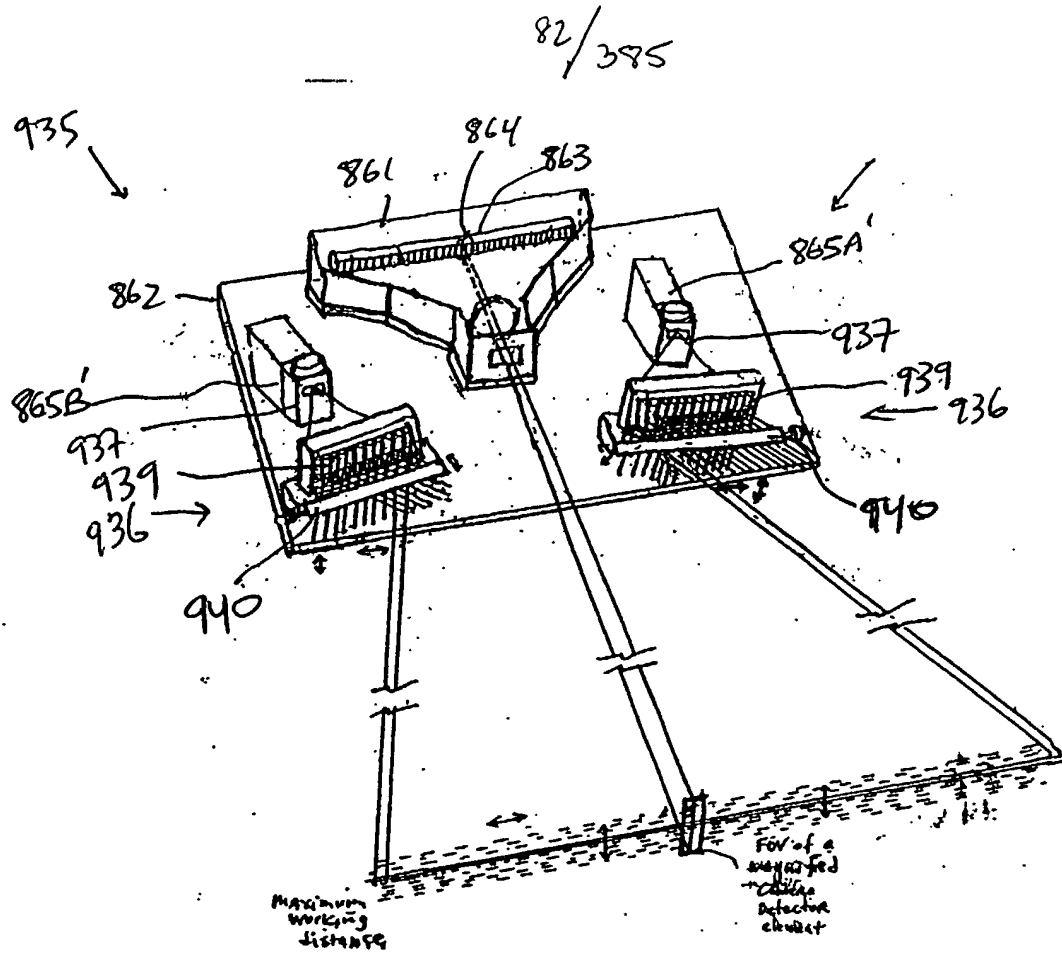


FIG. 1I25G2



\* Lateral and Transverse Misalignment of PLIB

FIG 1I25H1

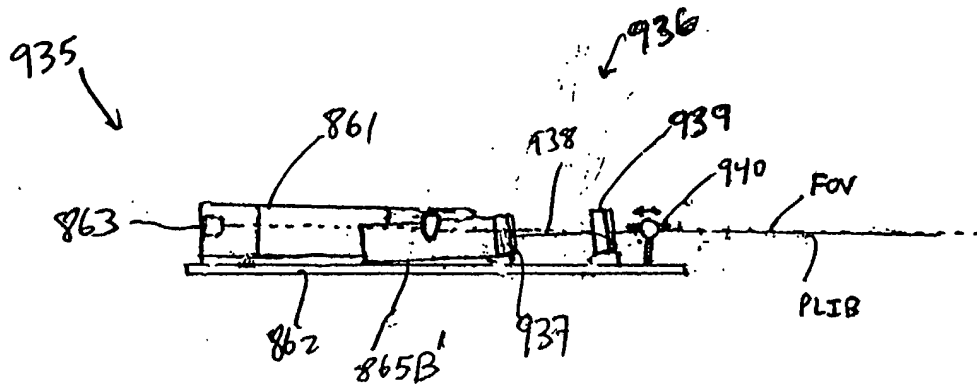
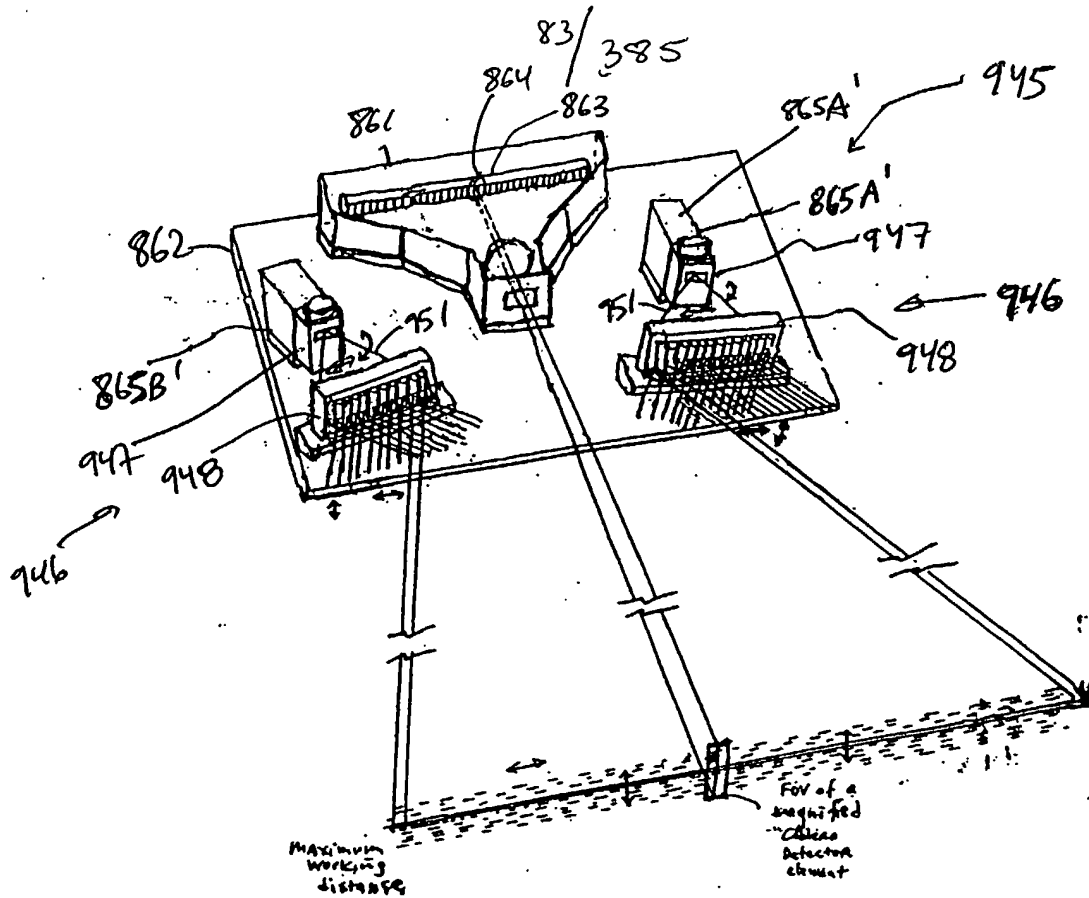


FIG 1I25H2



Literal and  
Transverse  
Excitation of PLIB

FIG. 1 I 25 I 1

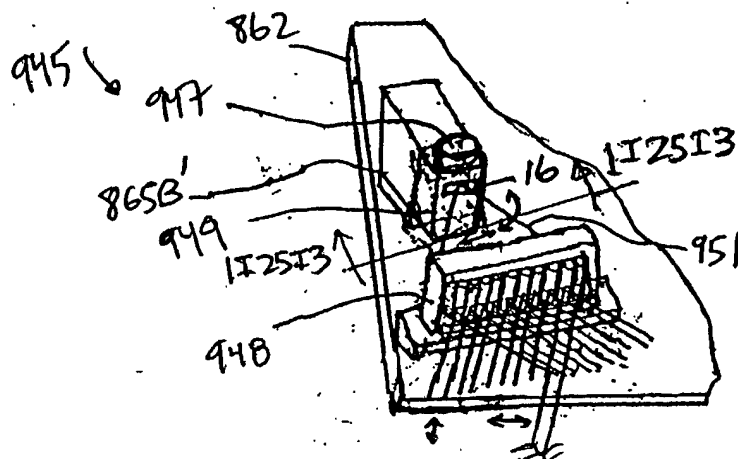


FIG. 1I25I2

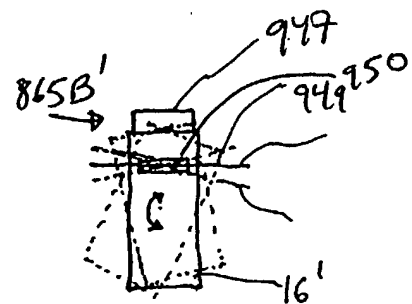


FIG. 1125I3

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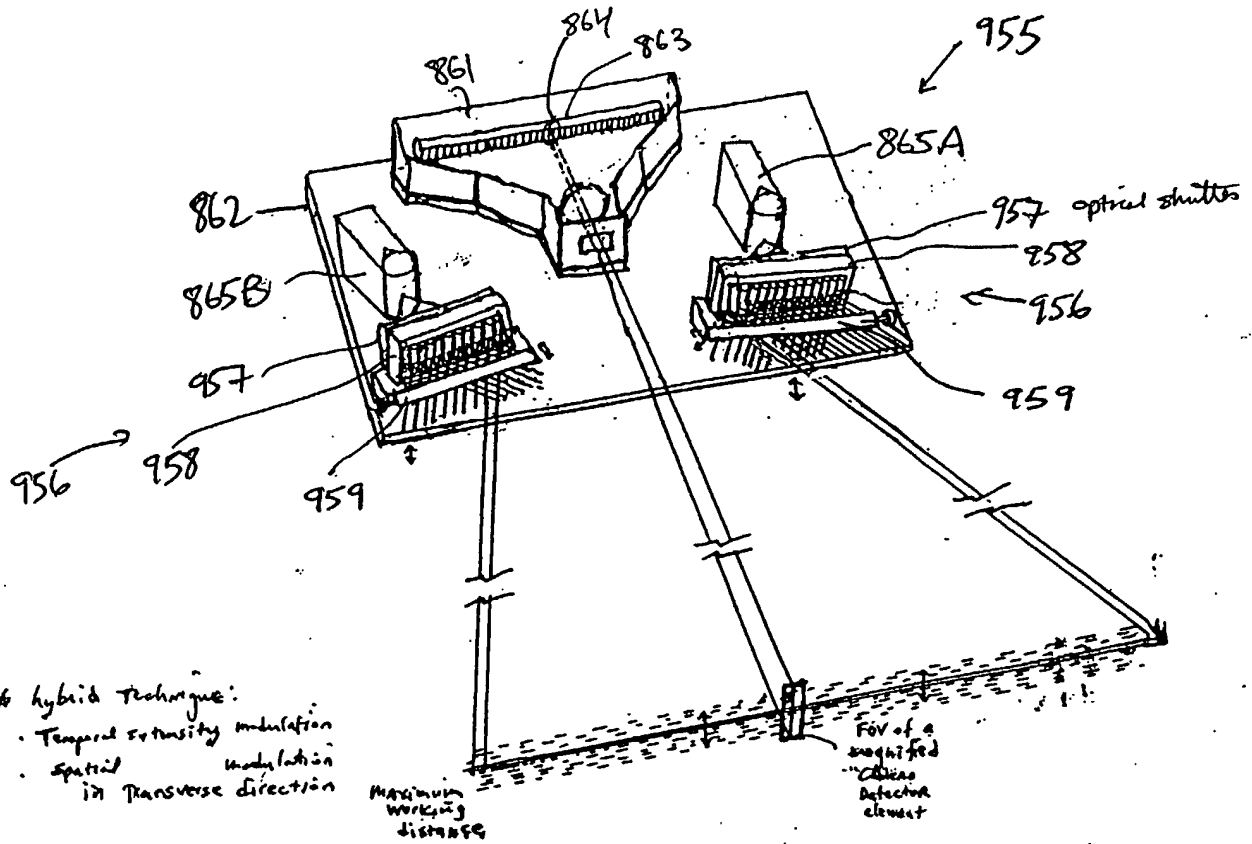


FIG. 1I25J1

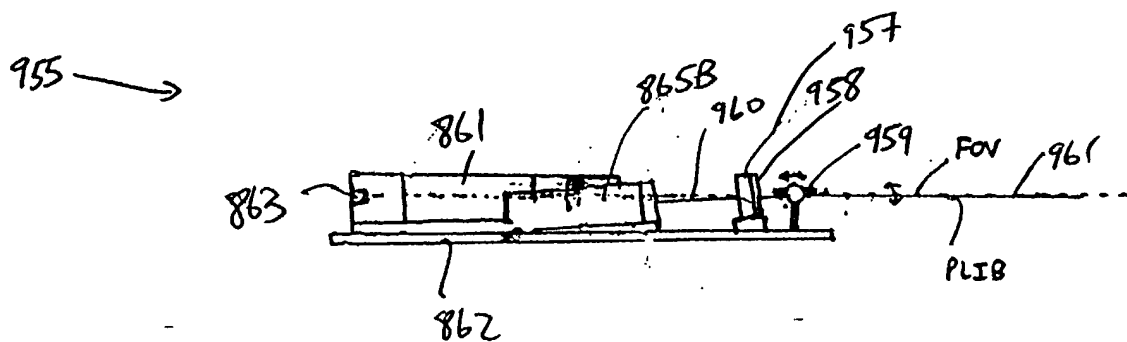
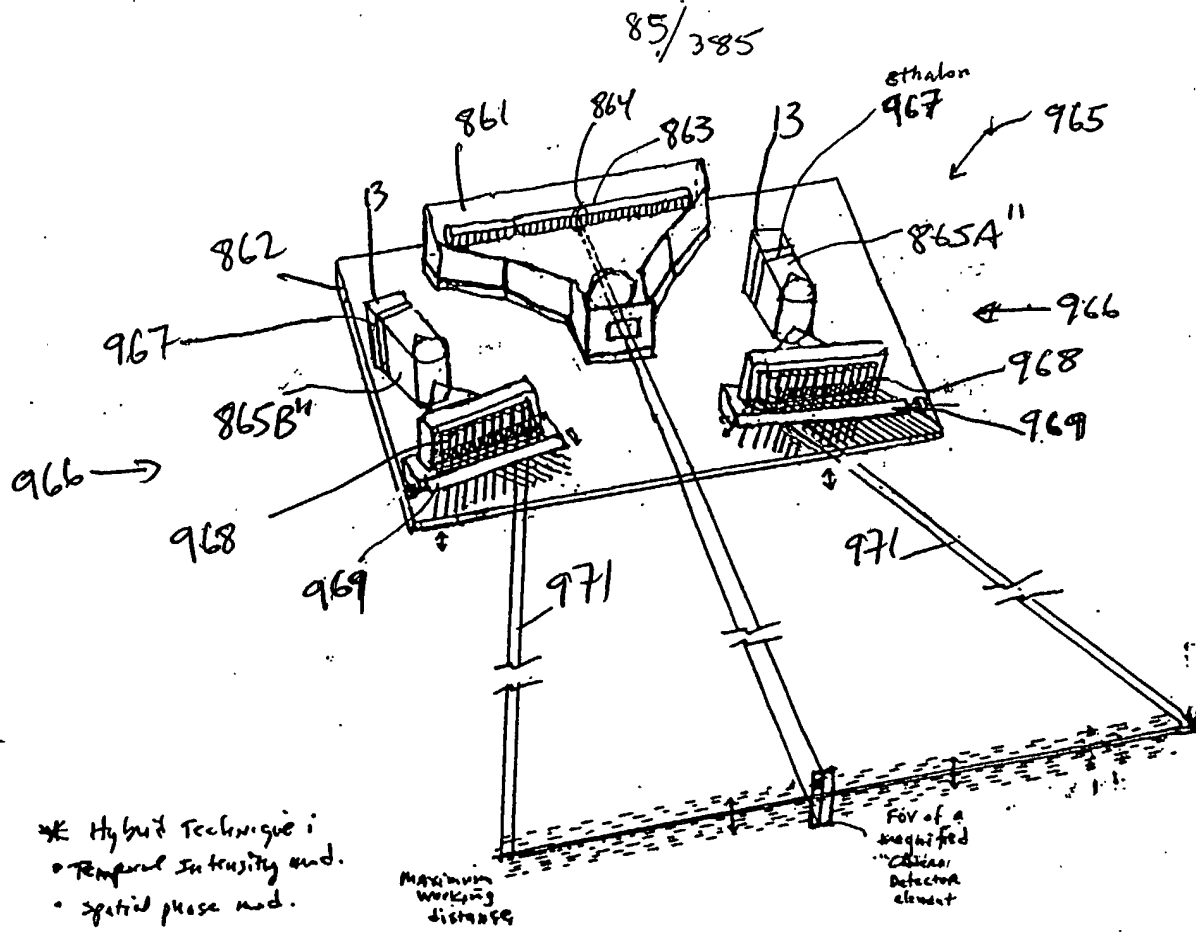


FIG. 1I25J2





\* Transverse Measurement of PLIB

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FIG. 1I25K1

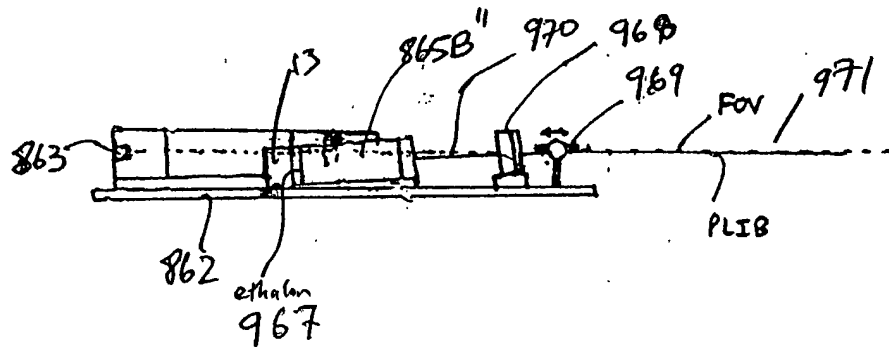
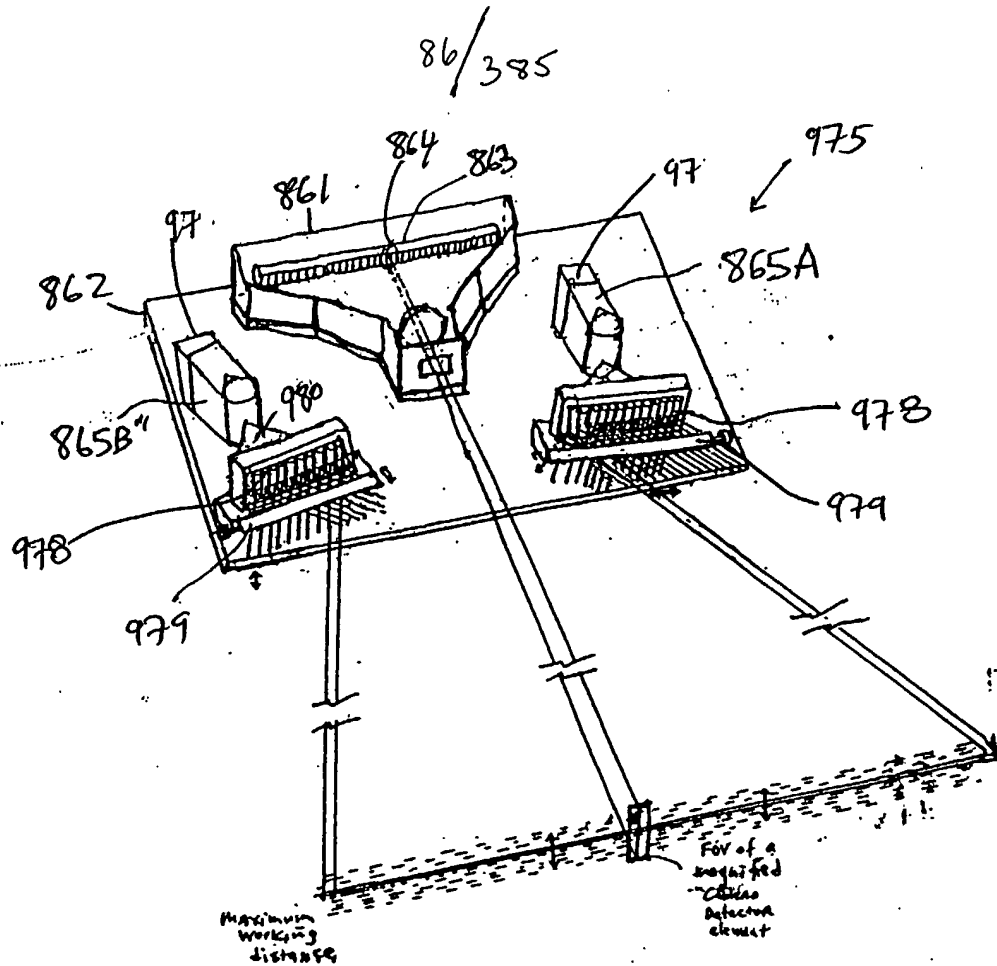


FIG. 1I25K2



- hybrid :
  - Temp freq. mod.
  - spatial phase mod.

\* Transverse  
vibration of PLIB

FIG. 1125L1

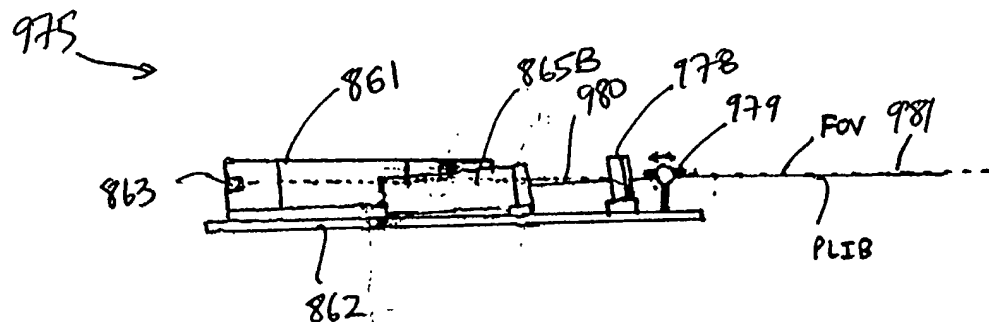


FIG. 1I25L2

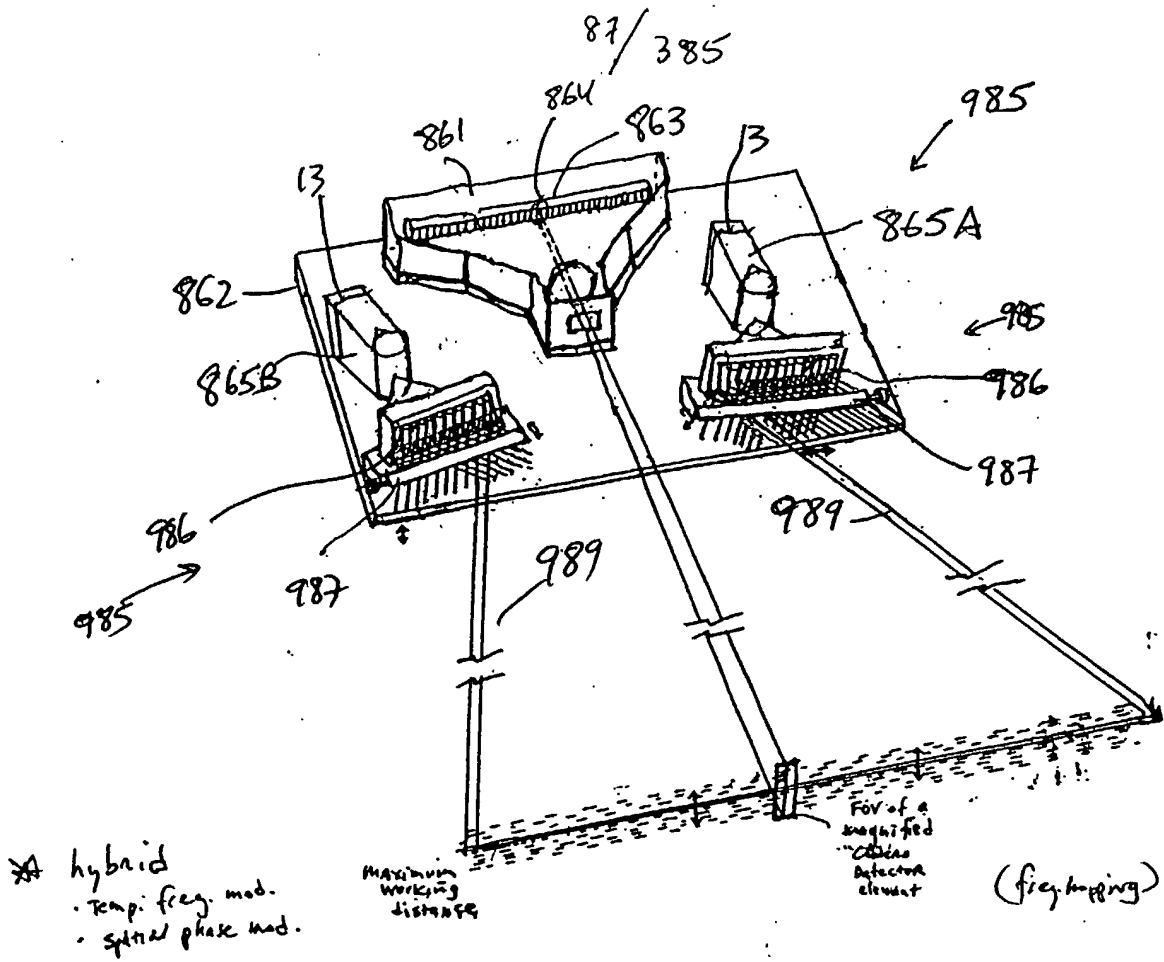


FIG. 1I25M1

\* Transverse  
 Modulation of PLIB

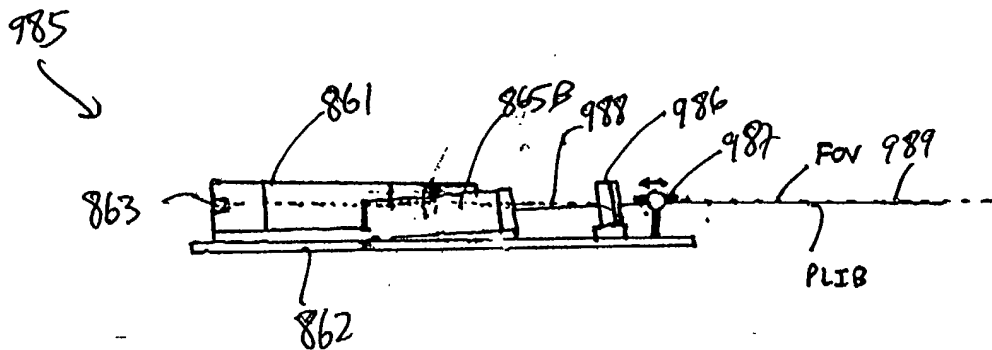
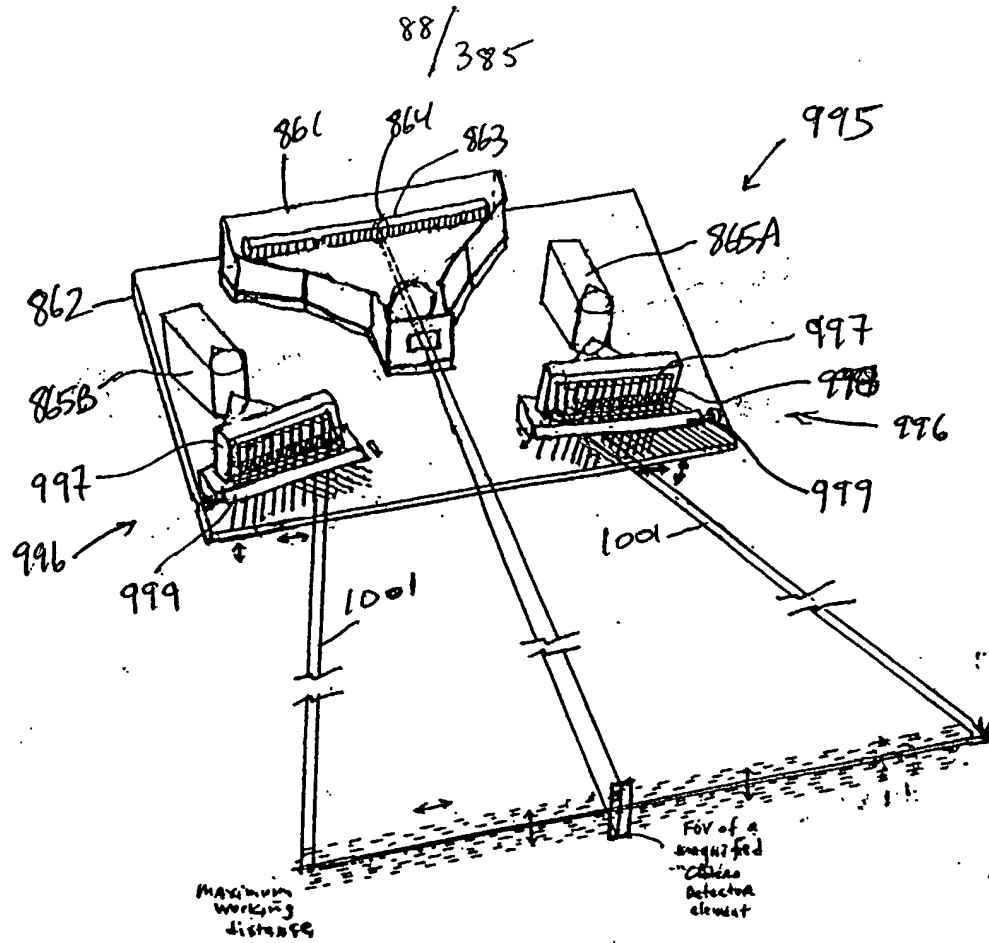


FIG. 1I25M2



- hybrid:
  - spatial intensity mod.
  - spatial phase
- \* lateral and Transverse Modulation of PLIB

FIG. 1I25N1

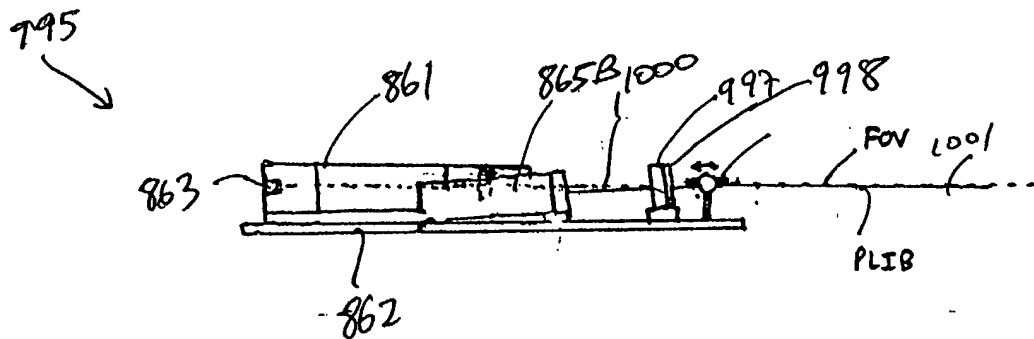


FIG. 1I25NZ

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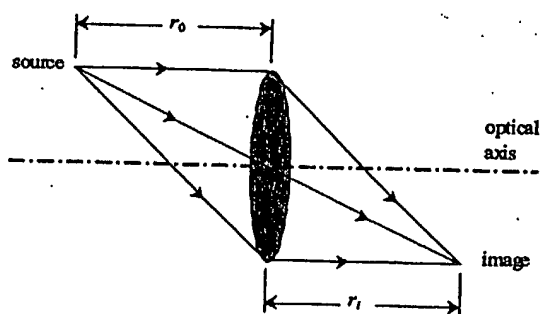


FIG. 1H1

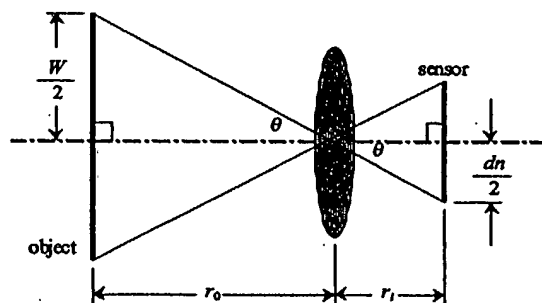


FIG. 1H2

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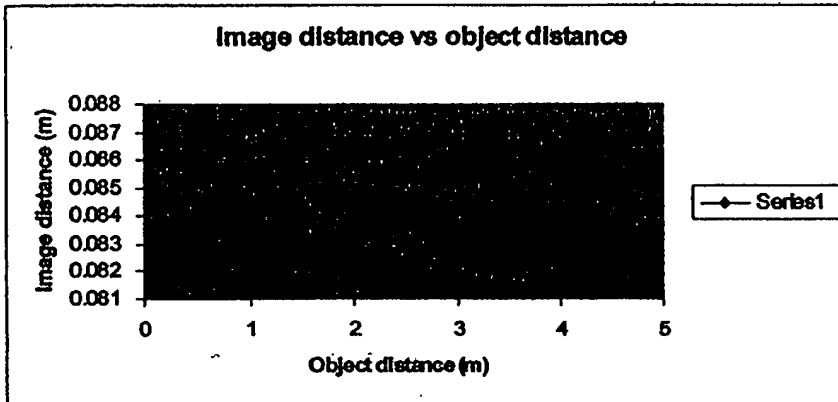


FIG. 1H3

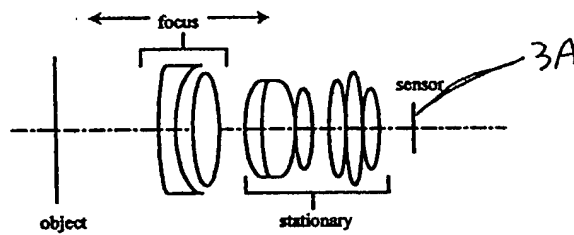


FIG. 1H4

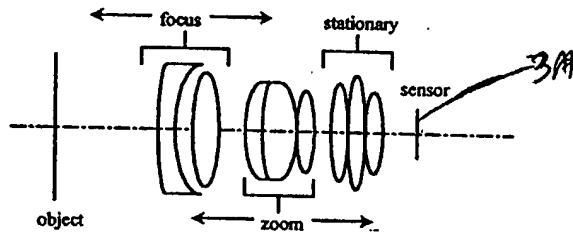
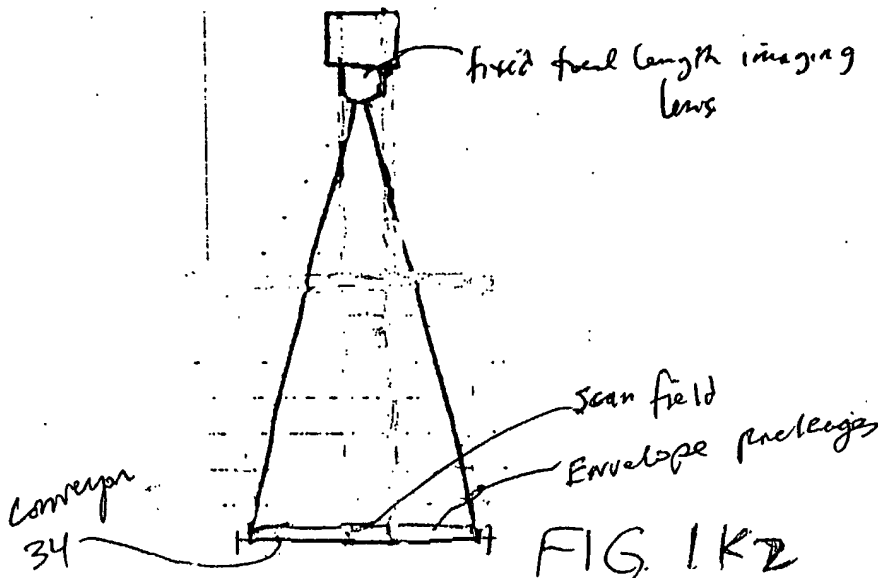
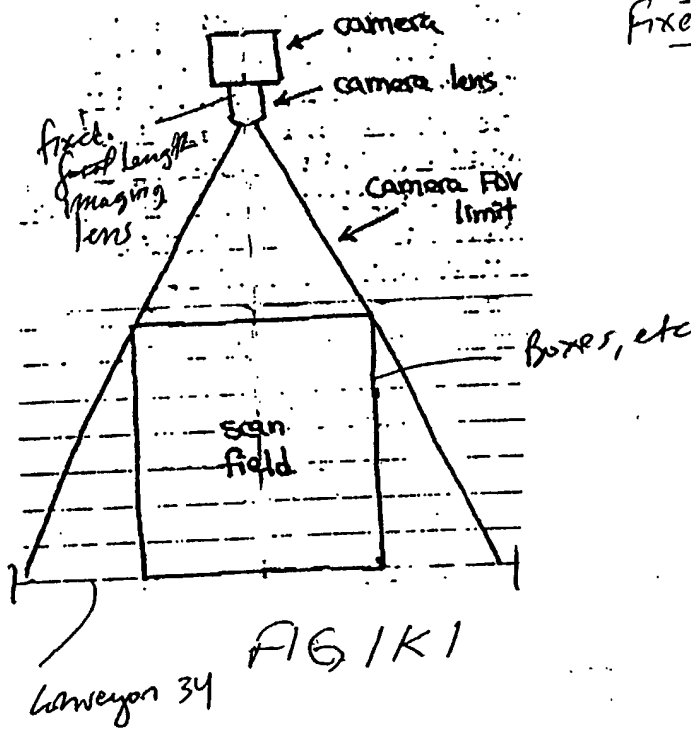
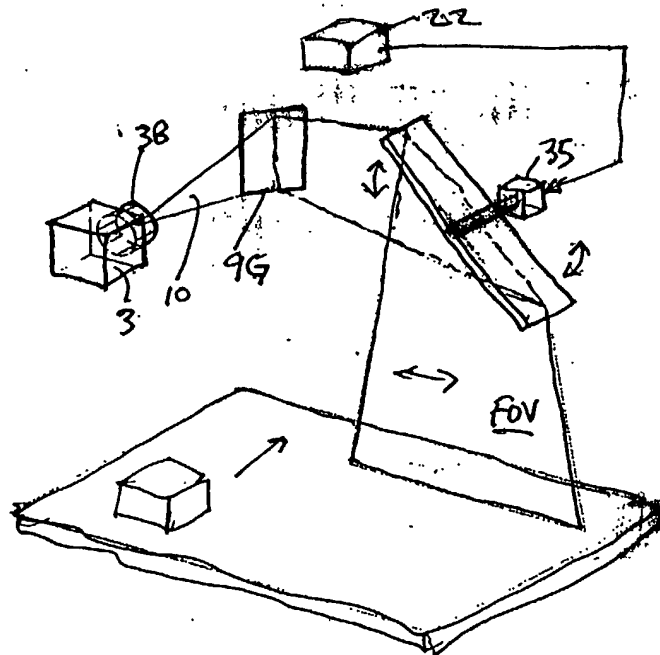
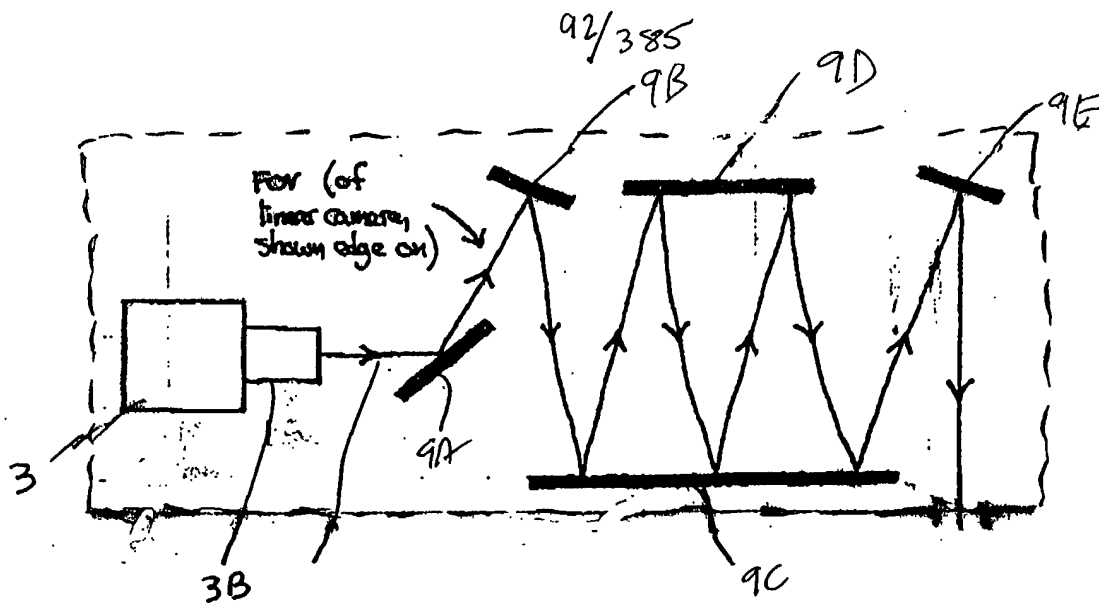


FIG. 1H5

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Fixed focal length lens cases







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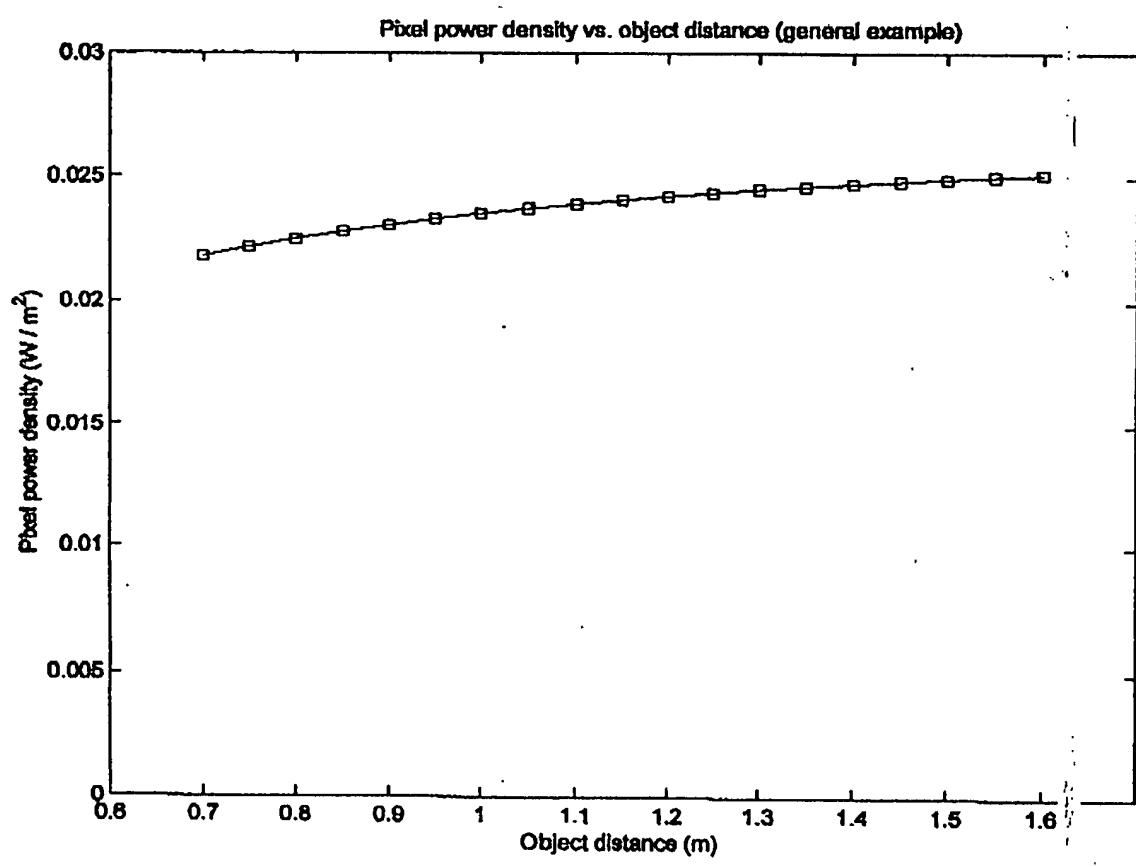


FIG-1M1

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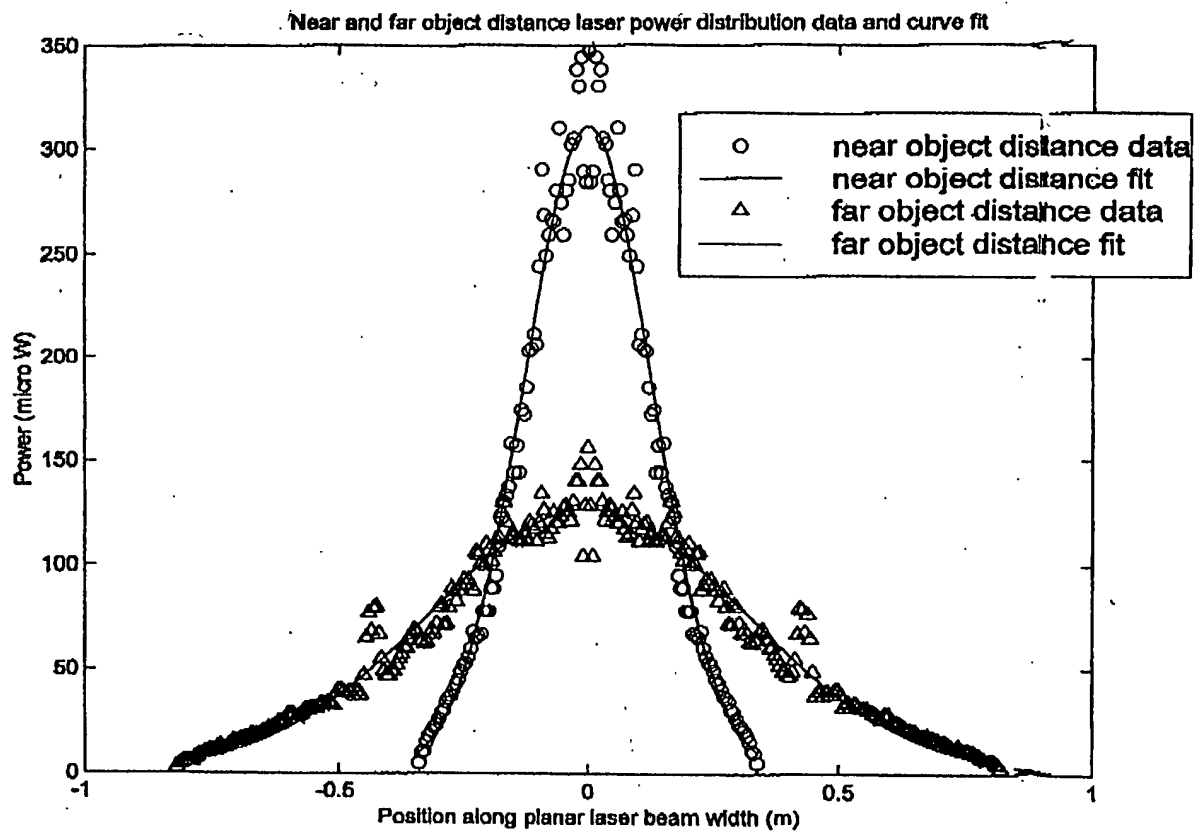


FIG. 1M2

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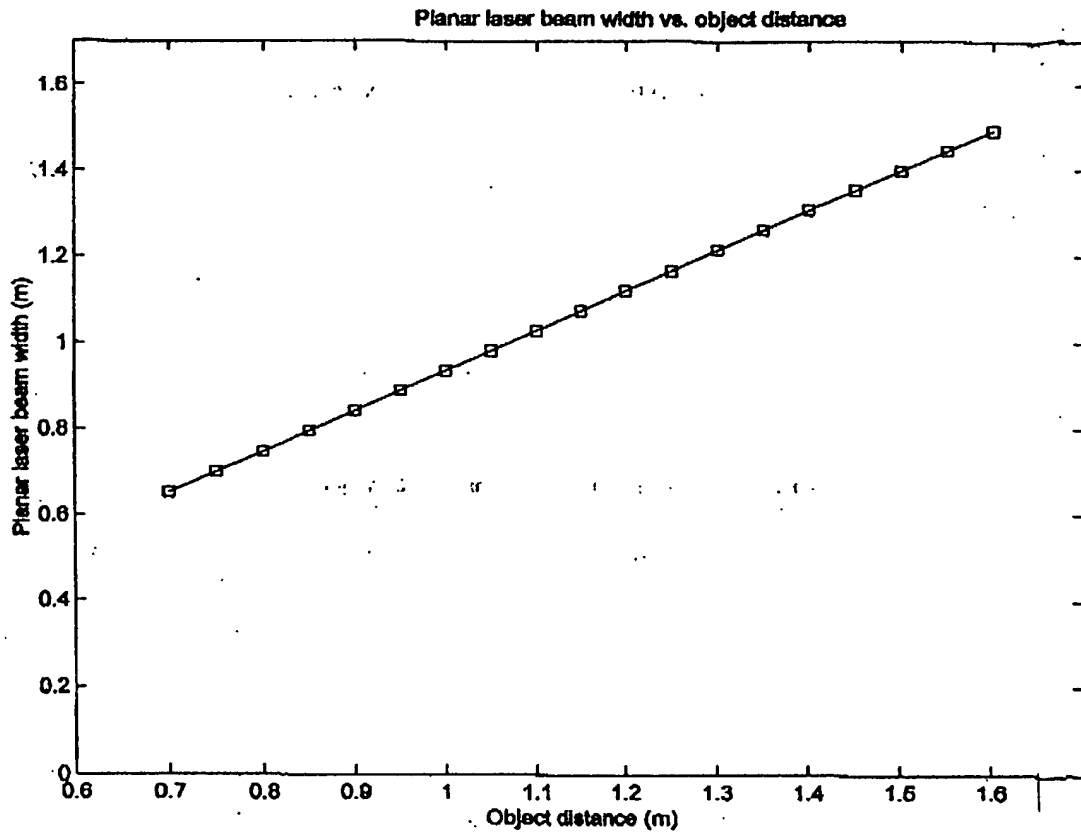
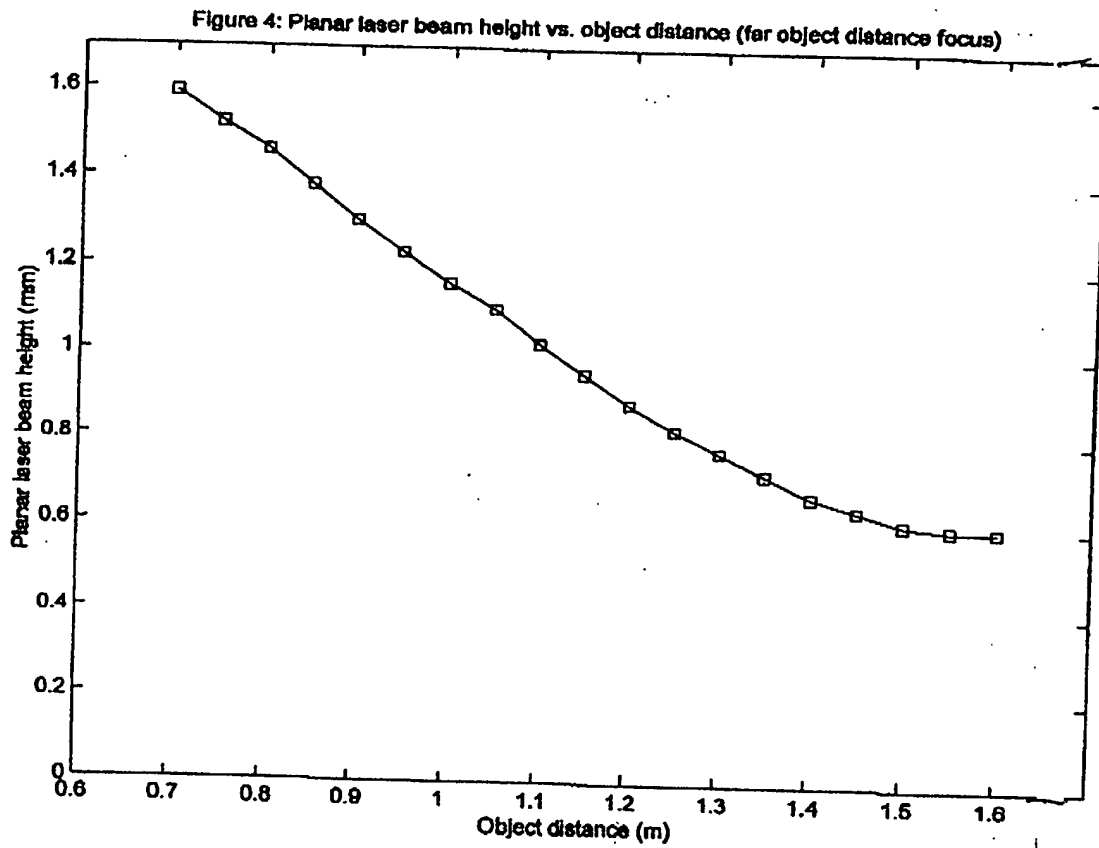


FIG. 1M3

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FIG/M4

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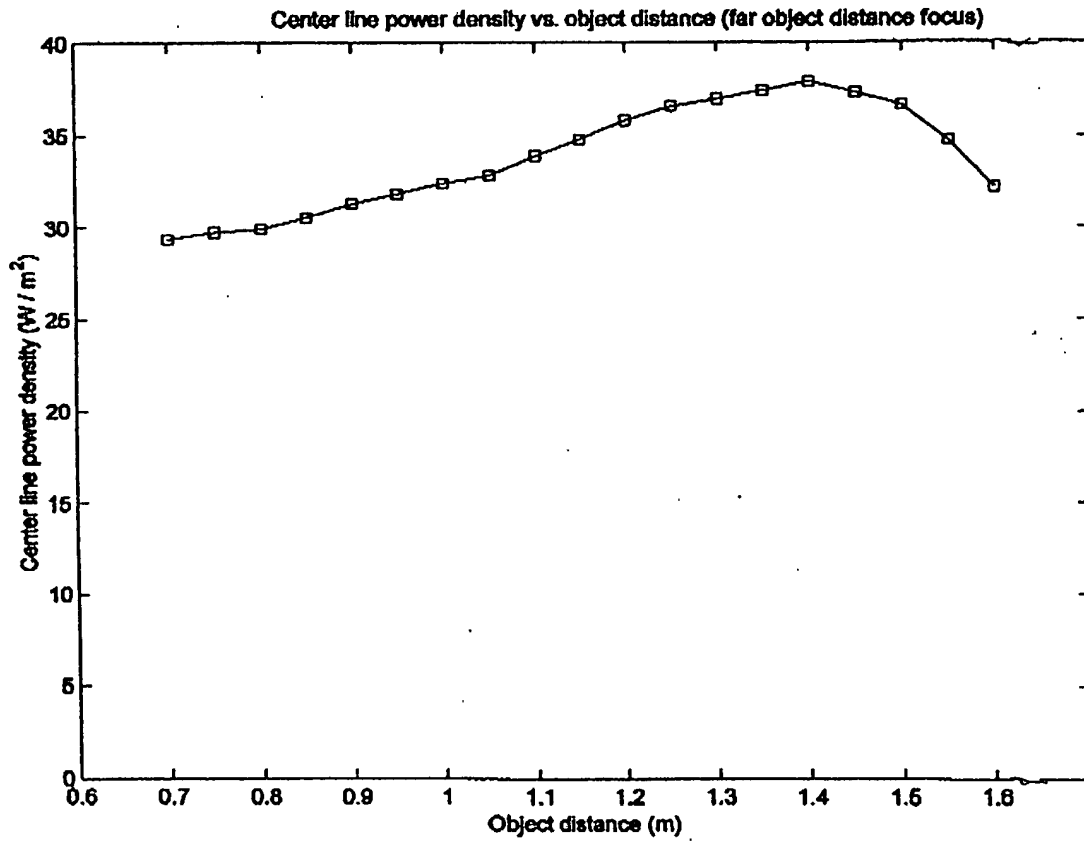


FIG. 1N

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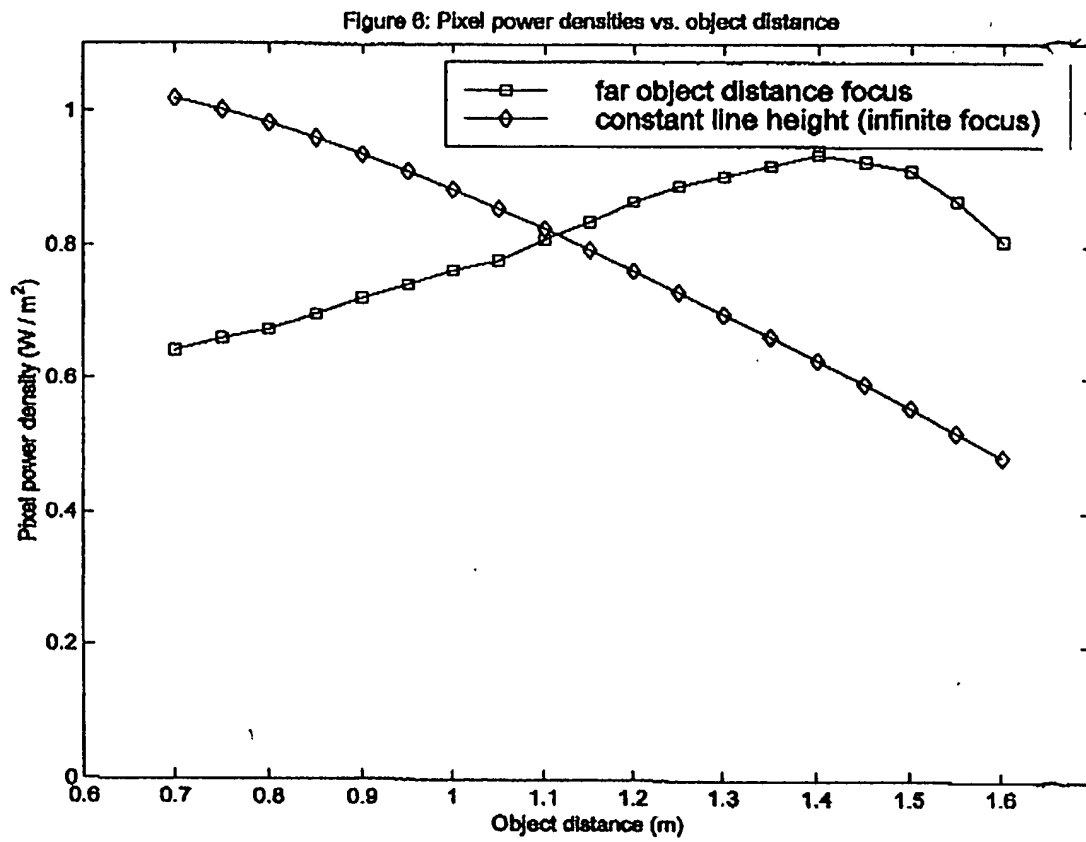


FIG. 10

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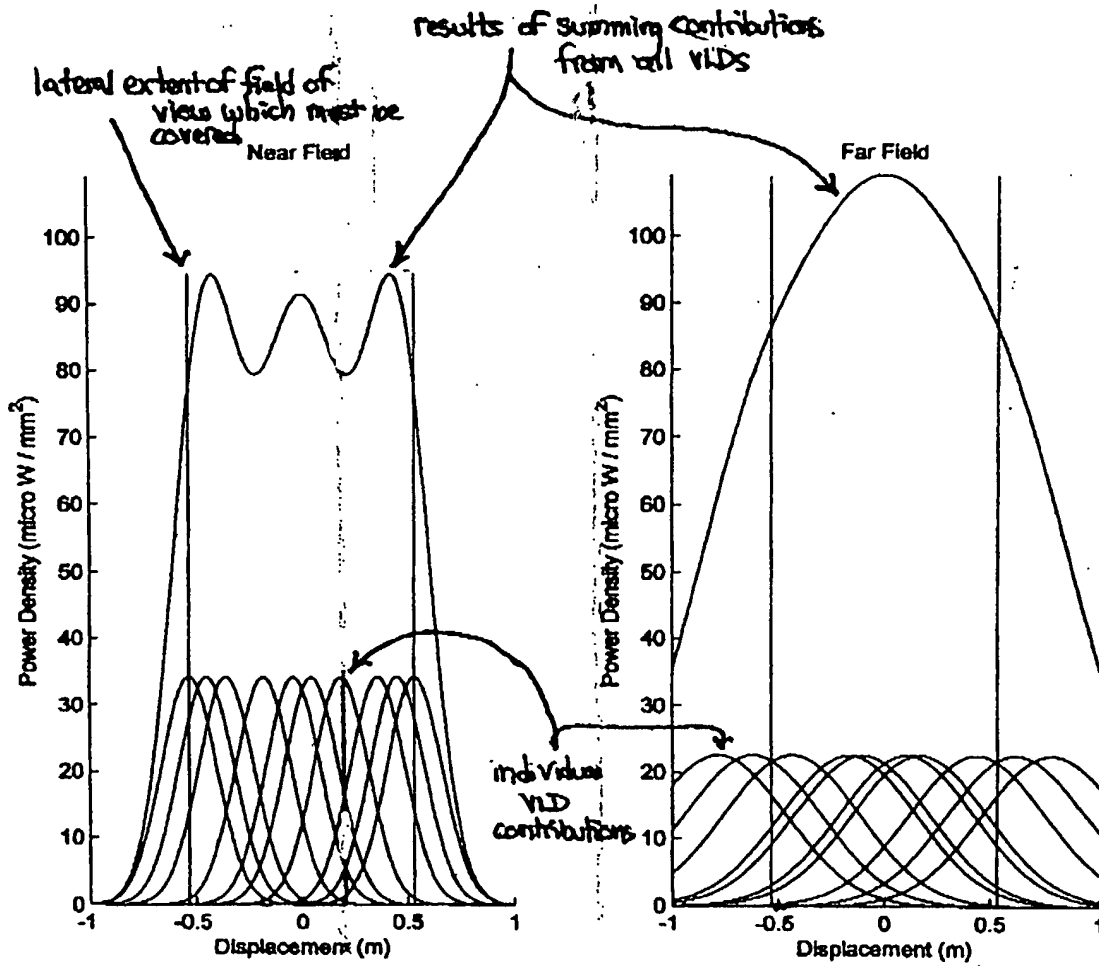


FIG 1P1

FIG 1P2

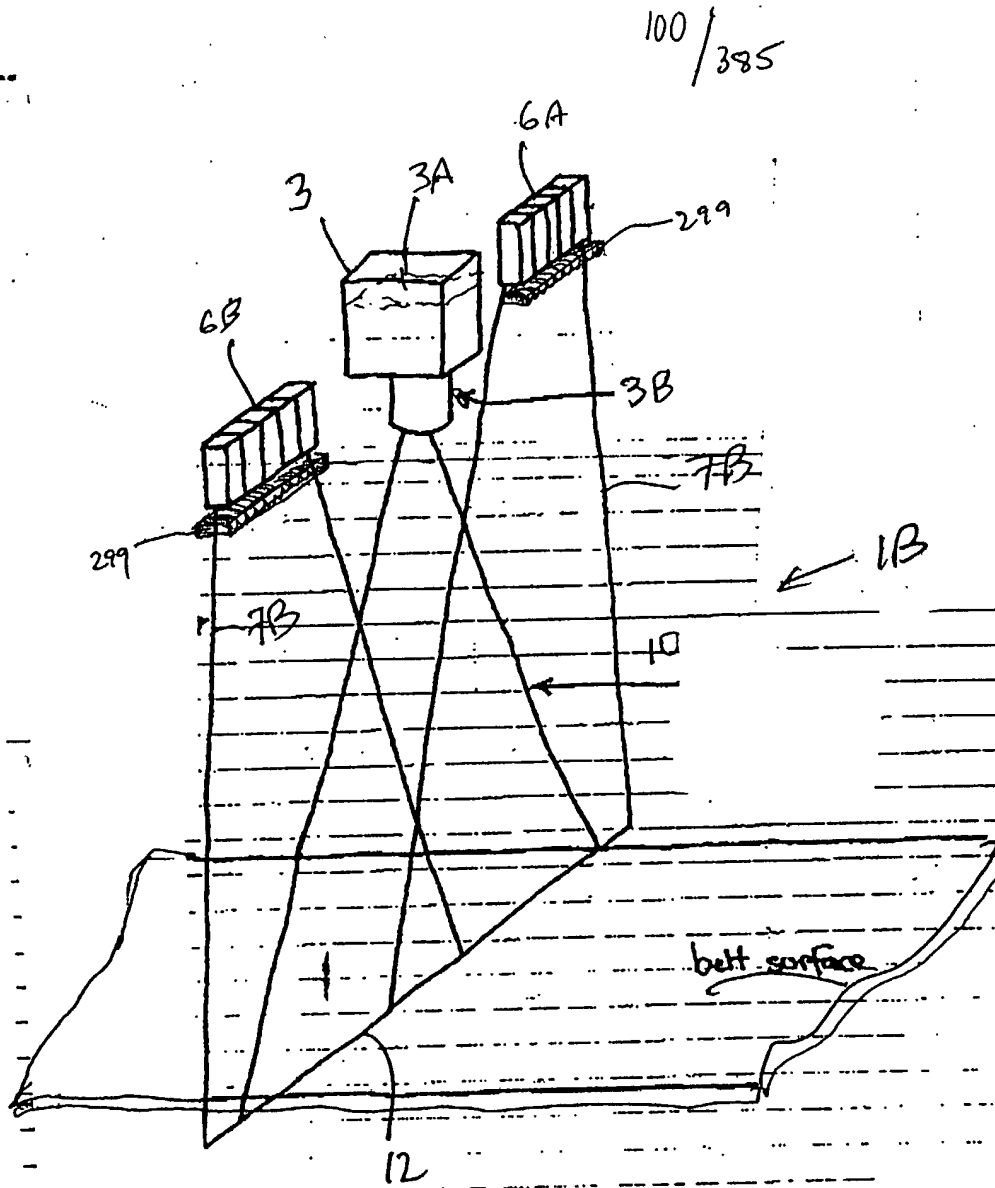
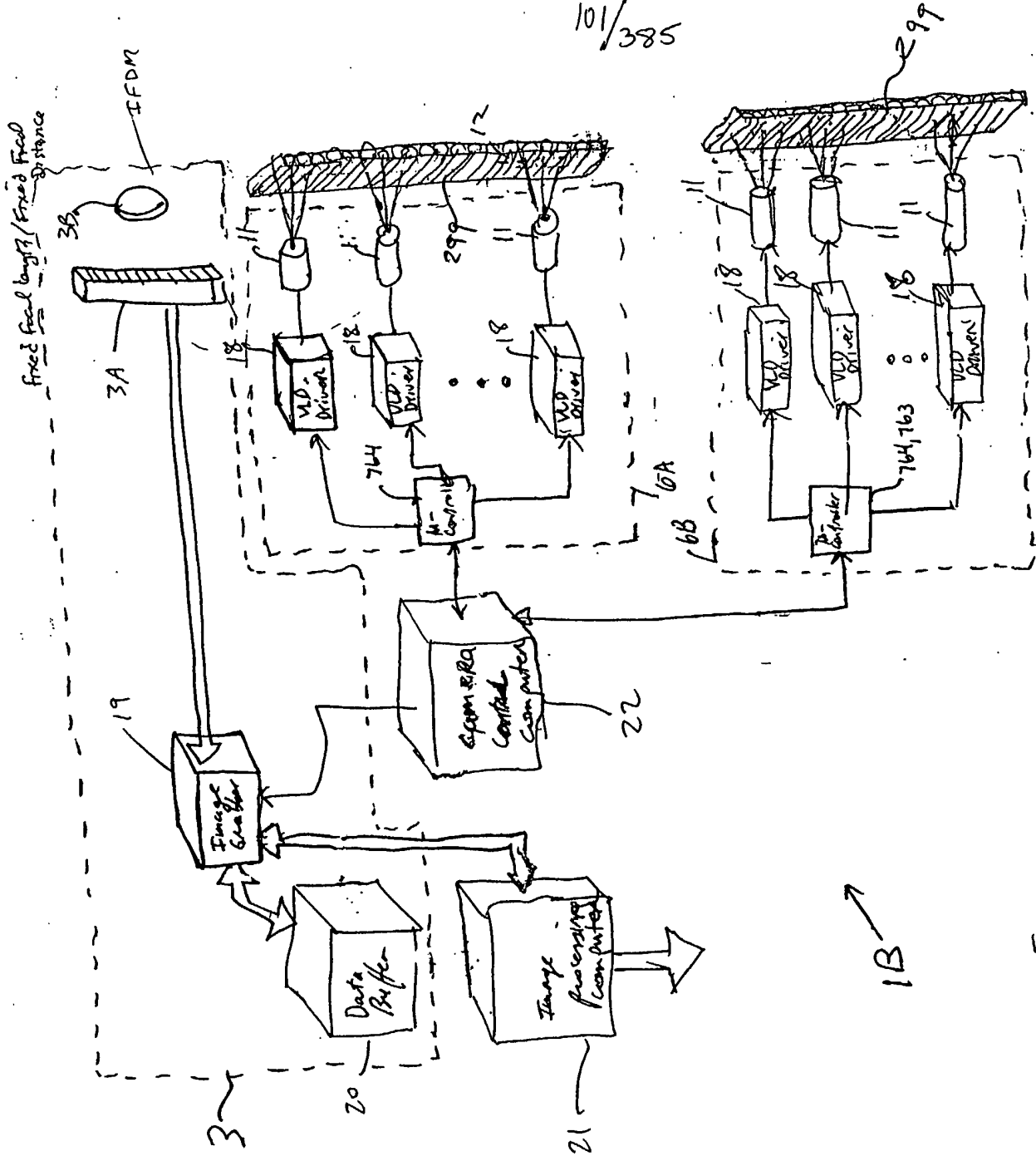


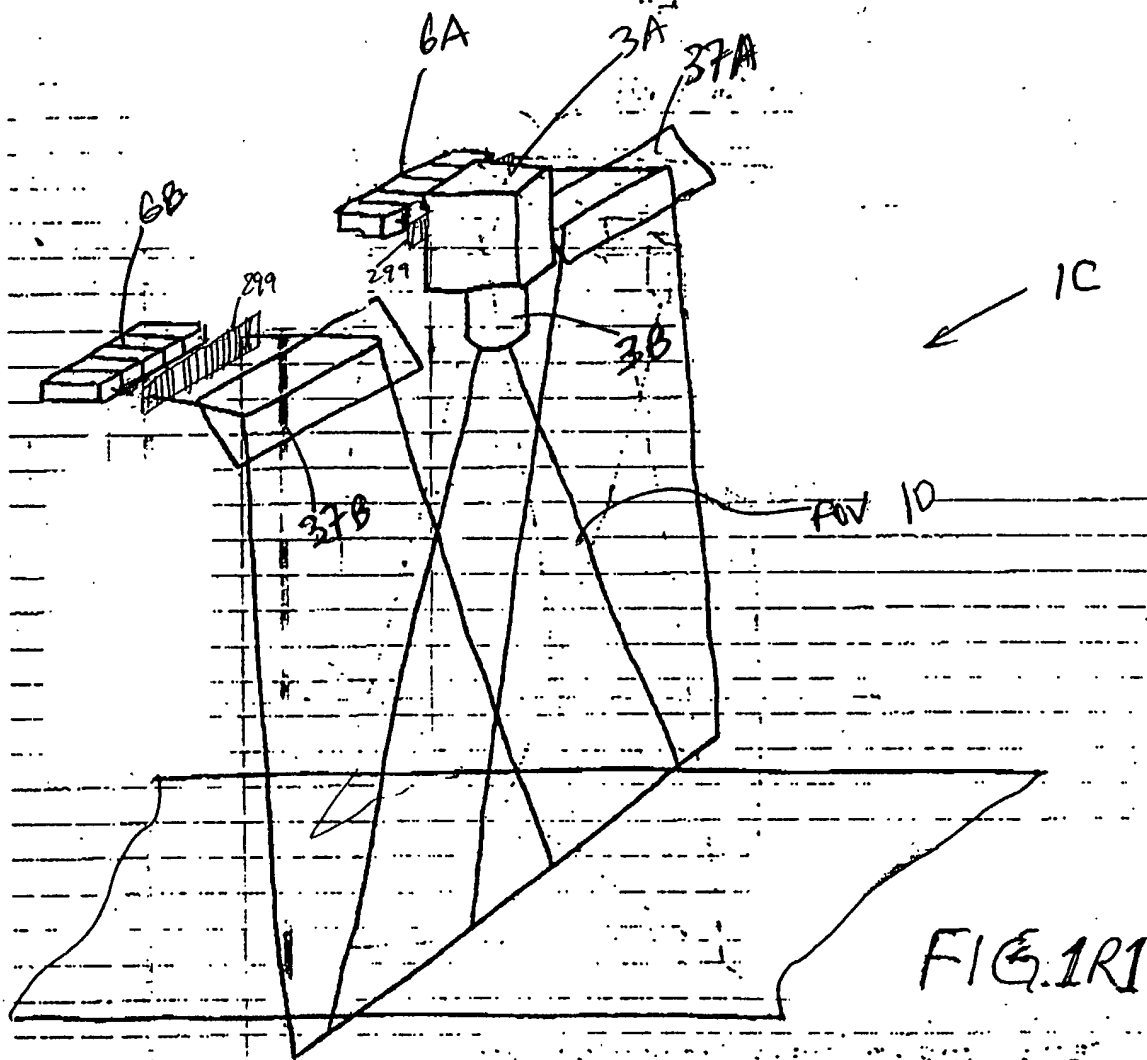
FIG. 1Q1



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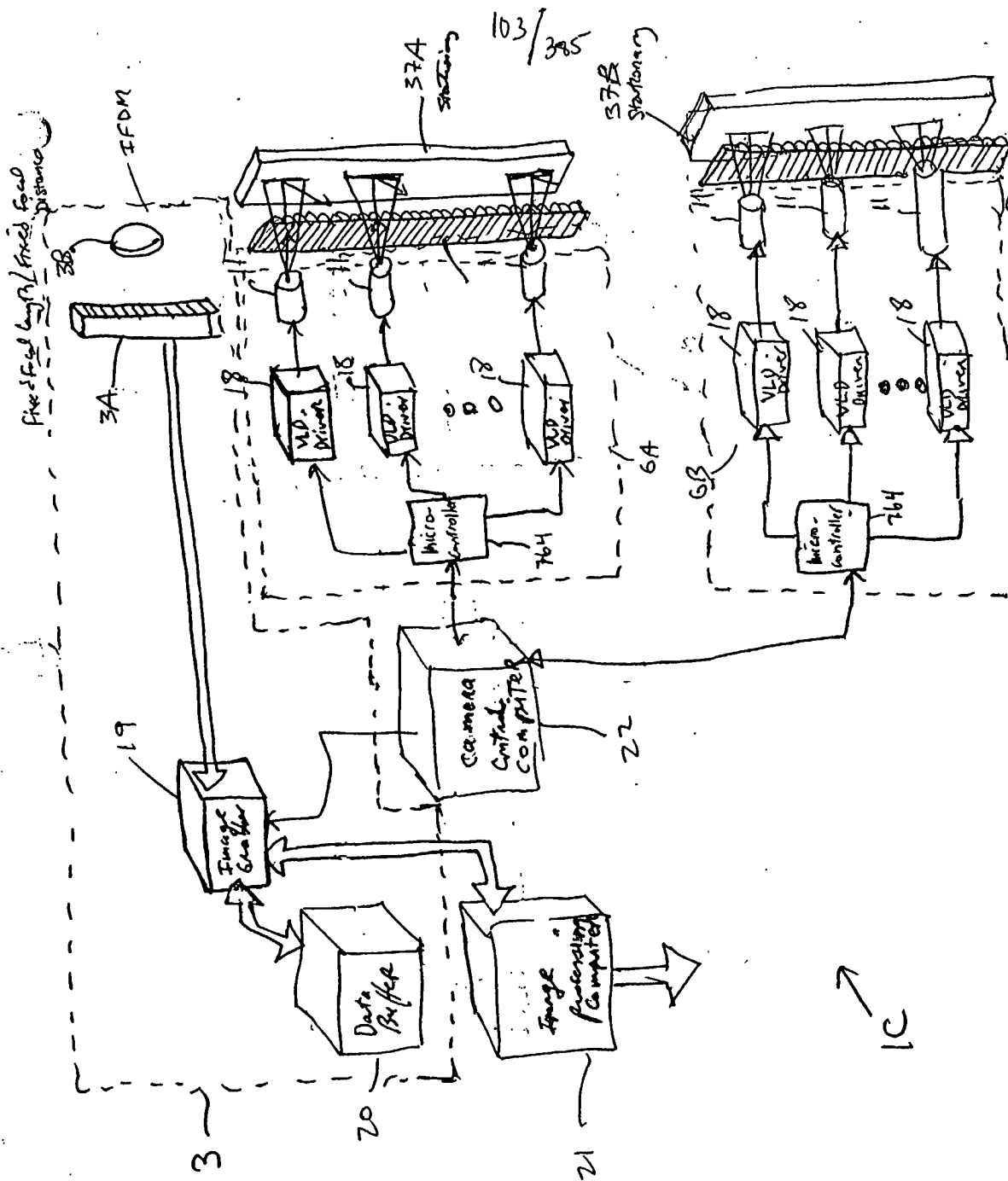


FIG. 1R2

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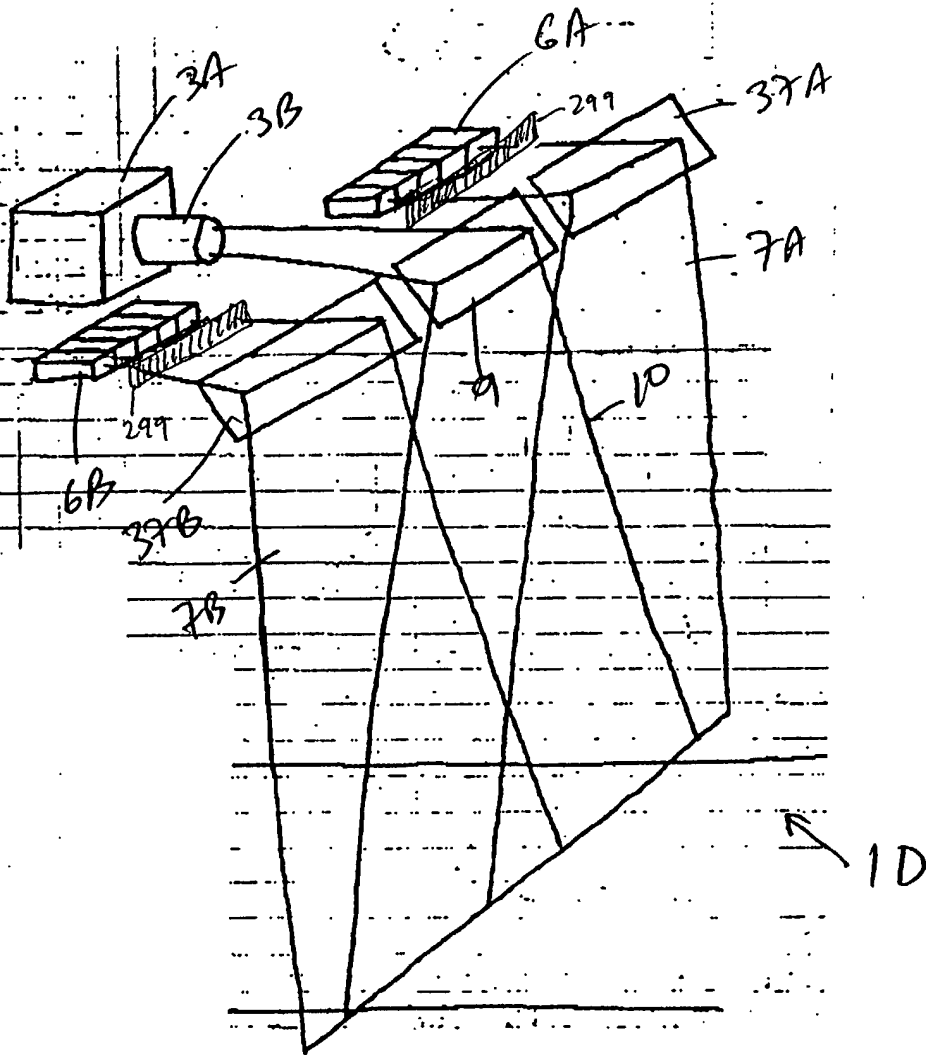


FIG. 1S1

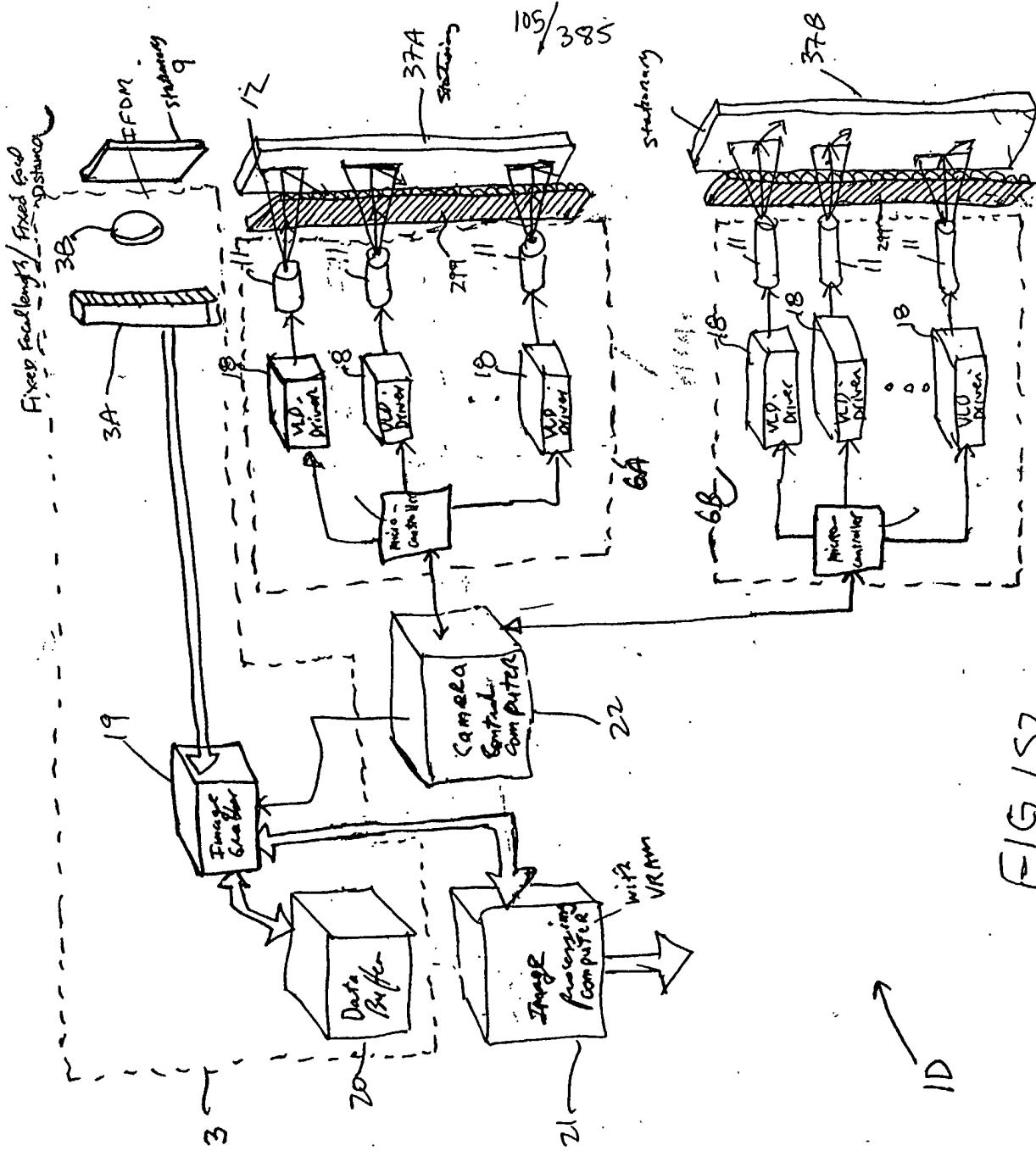


FIG. 1S2

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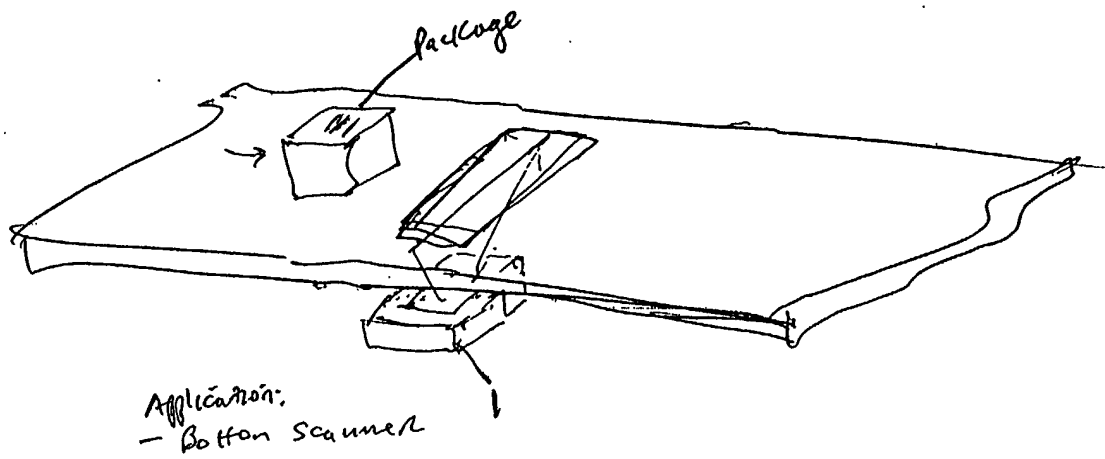
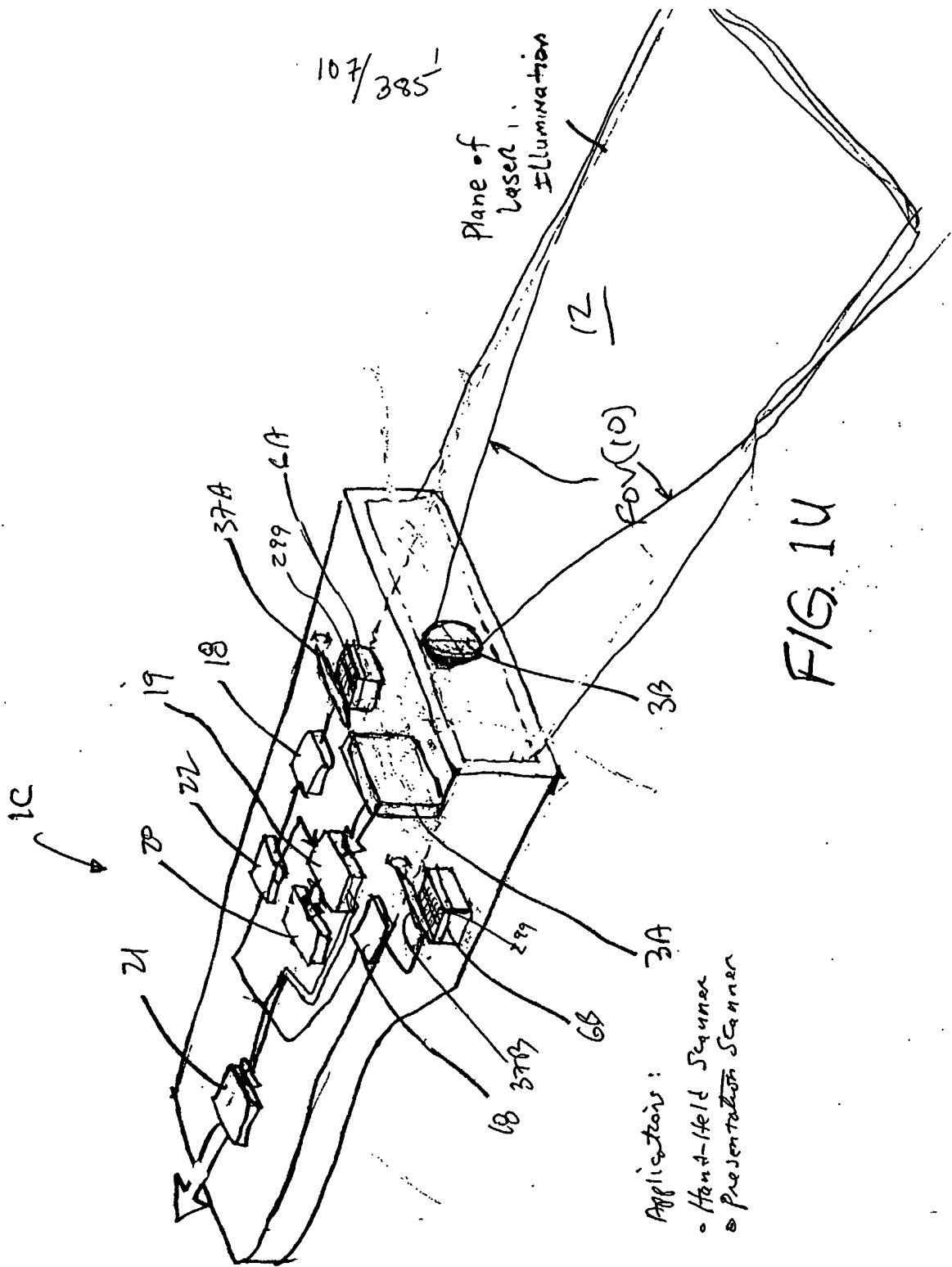


FIG 1T



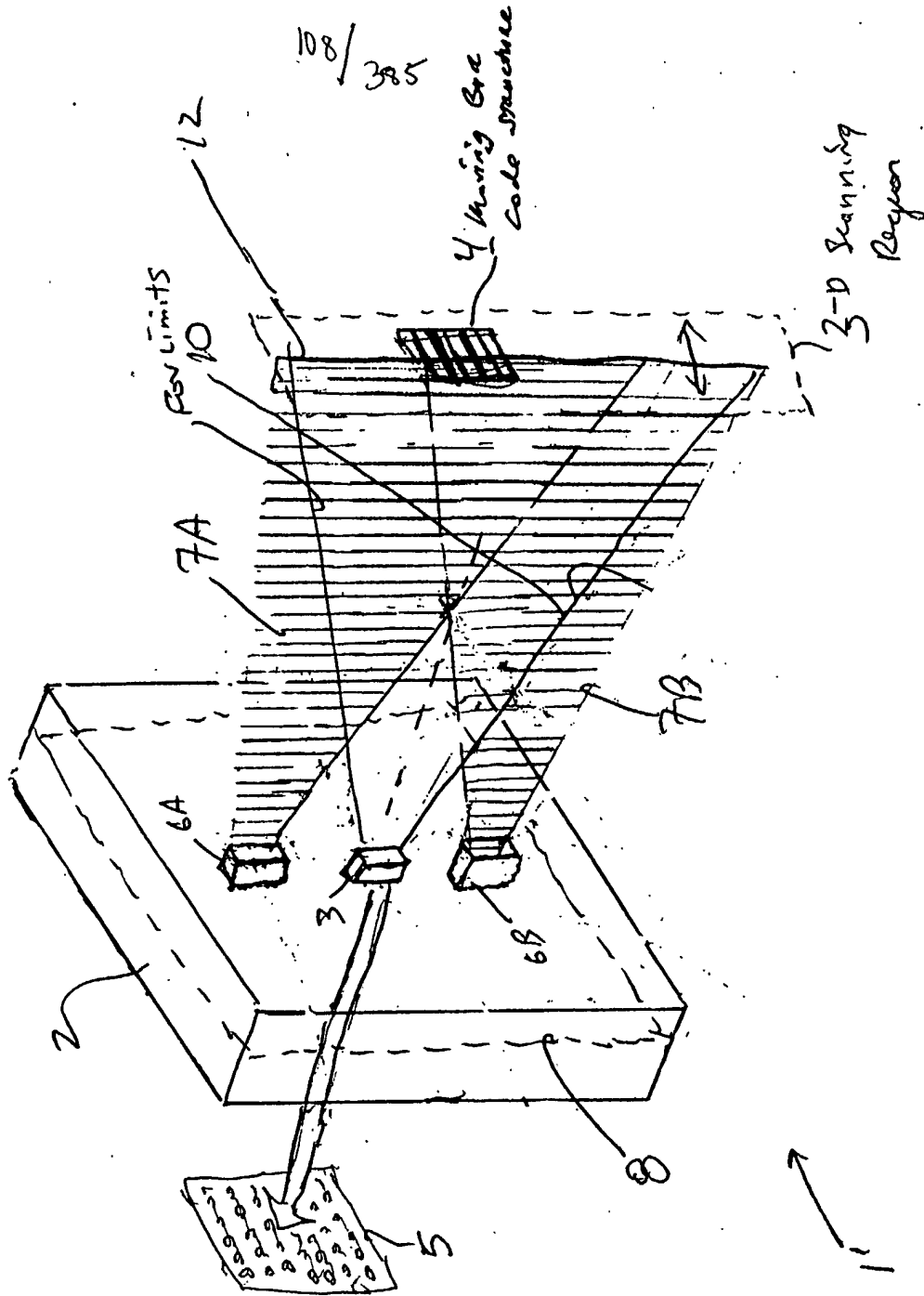
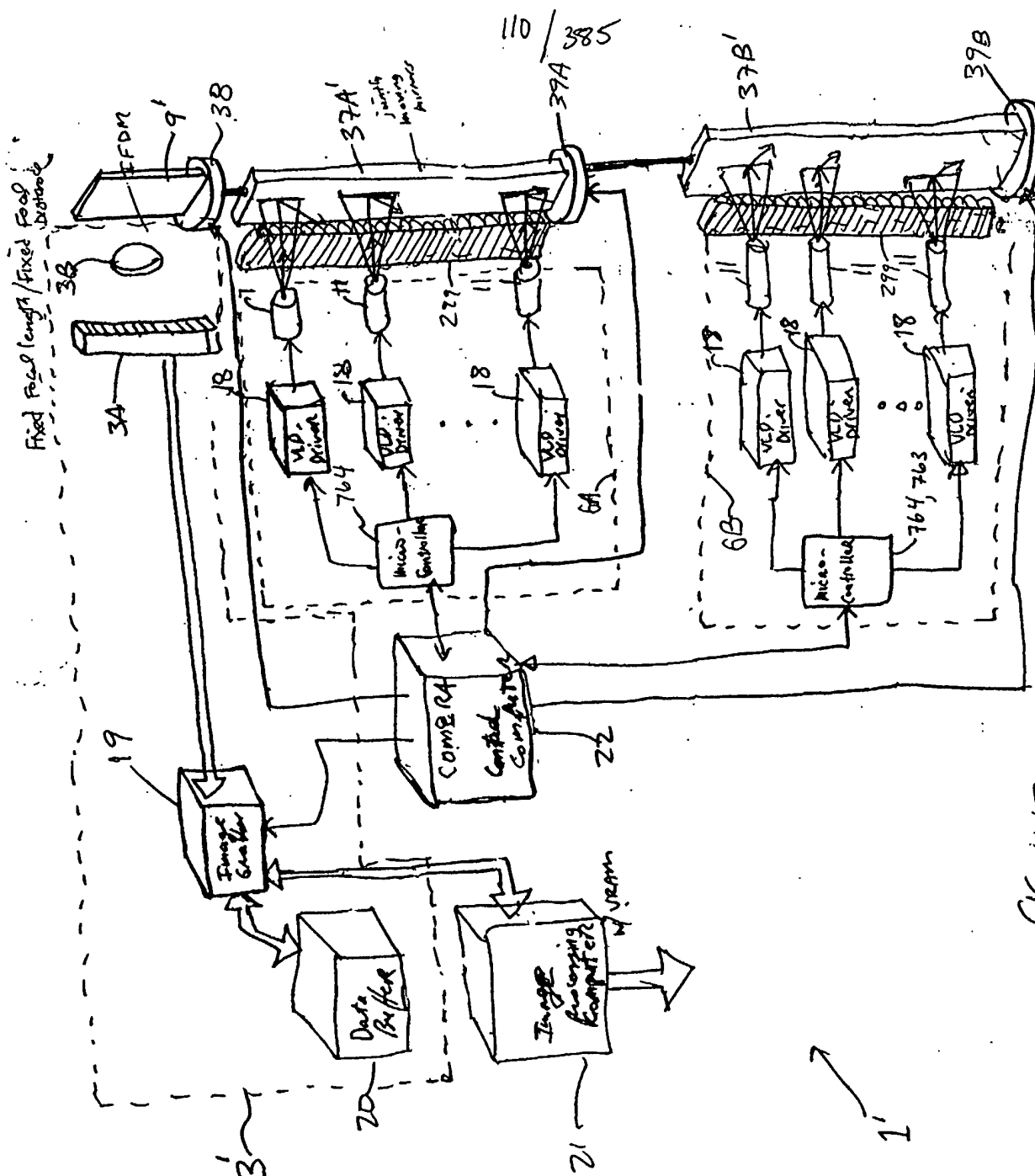


FIG. IVI



FIG. IV2

2-D  
Region  
Space



AG.1V3

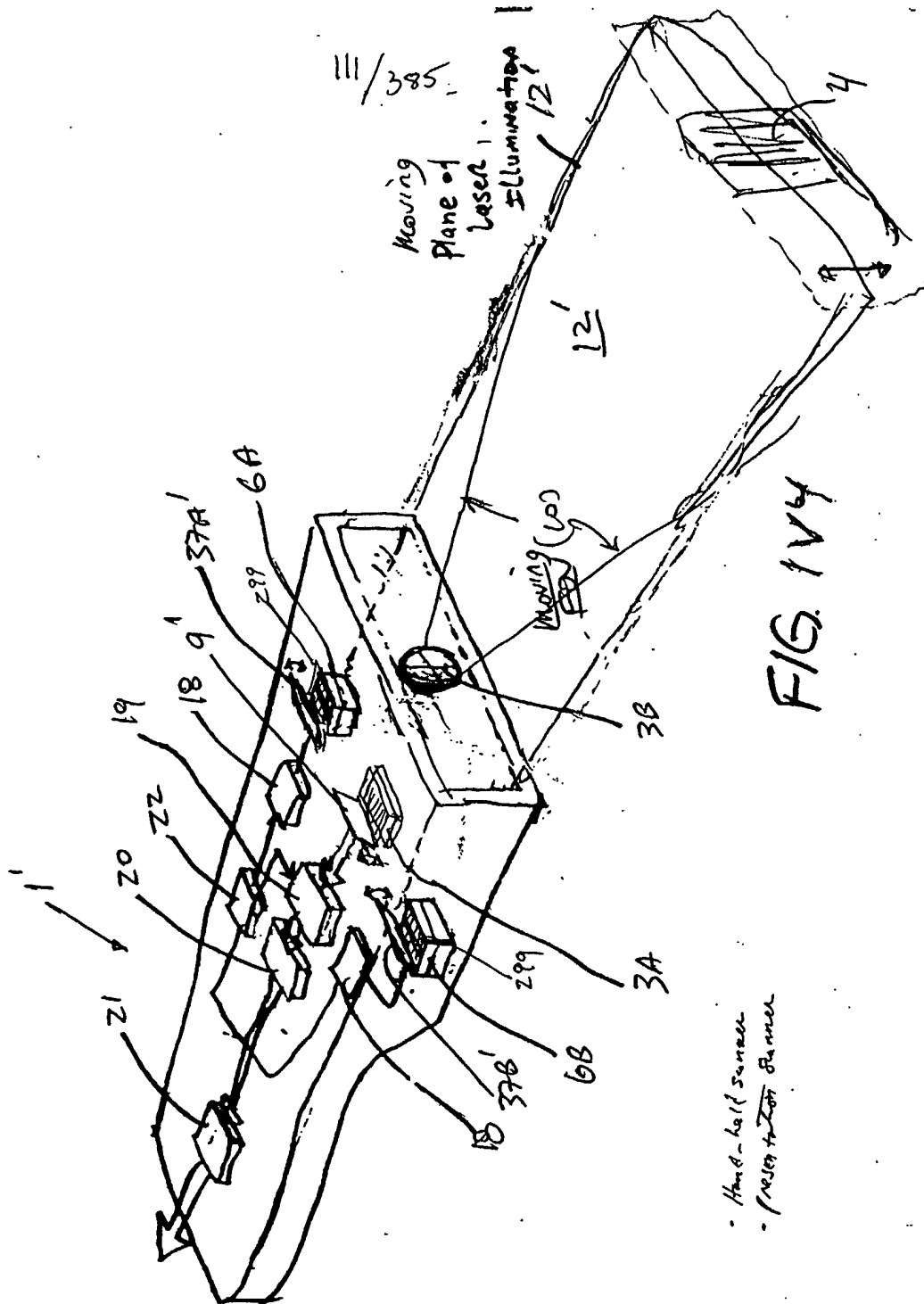


FIG. 1V4

- Hand-held sunshade  
- Presentation Banner

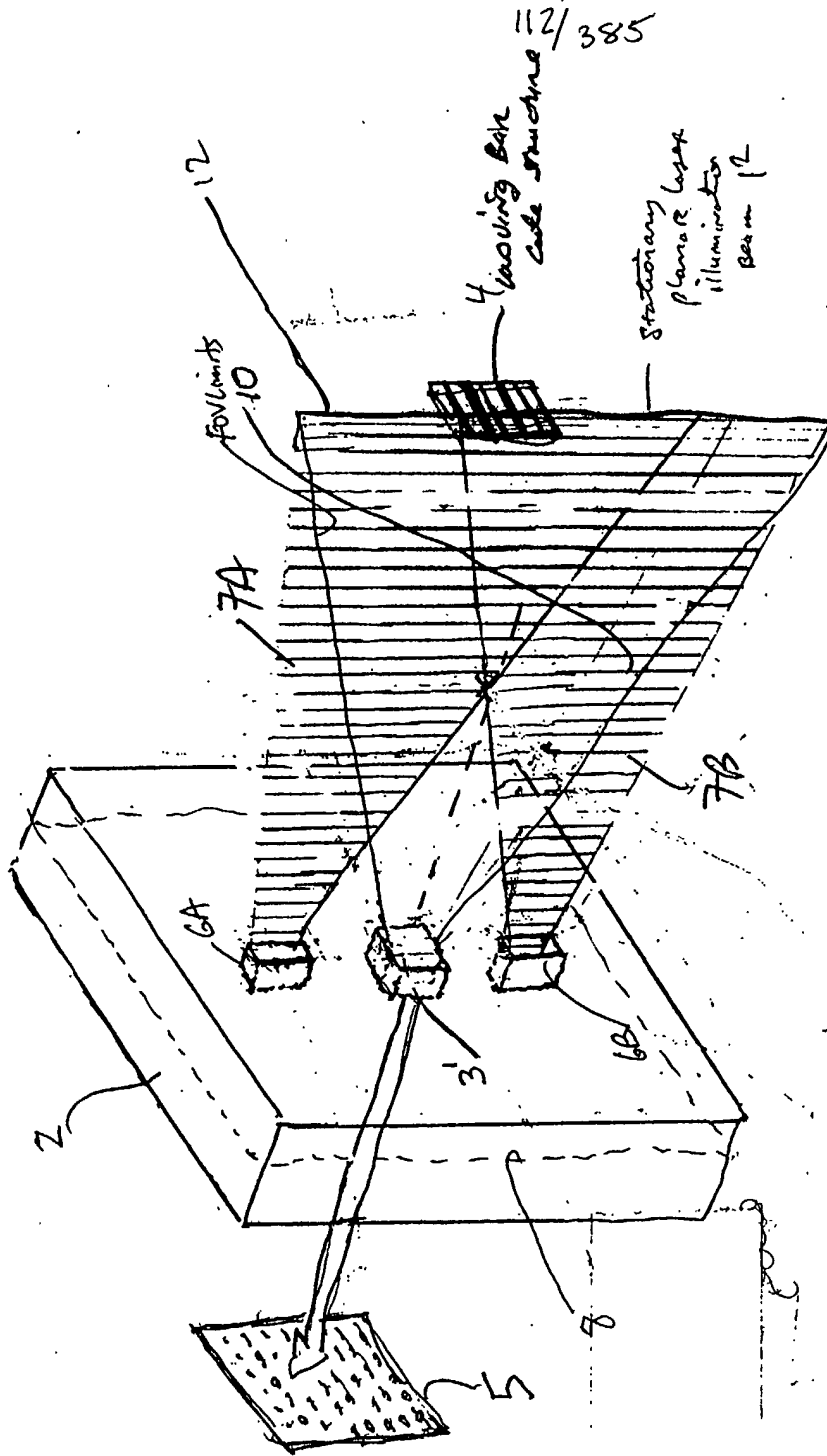
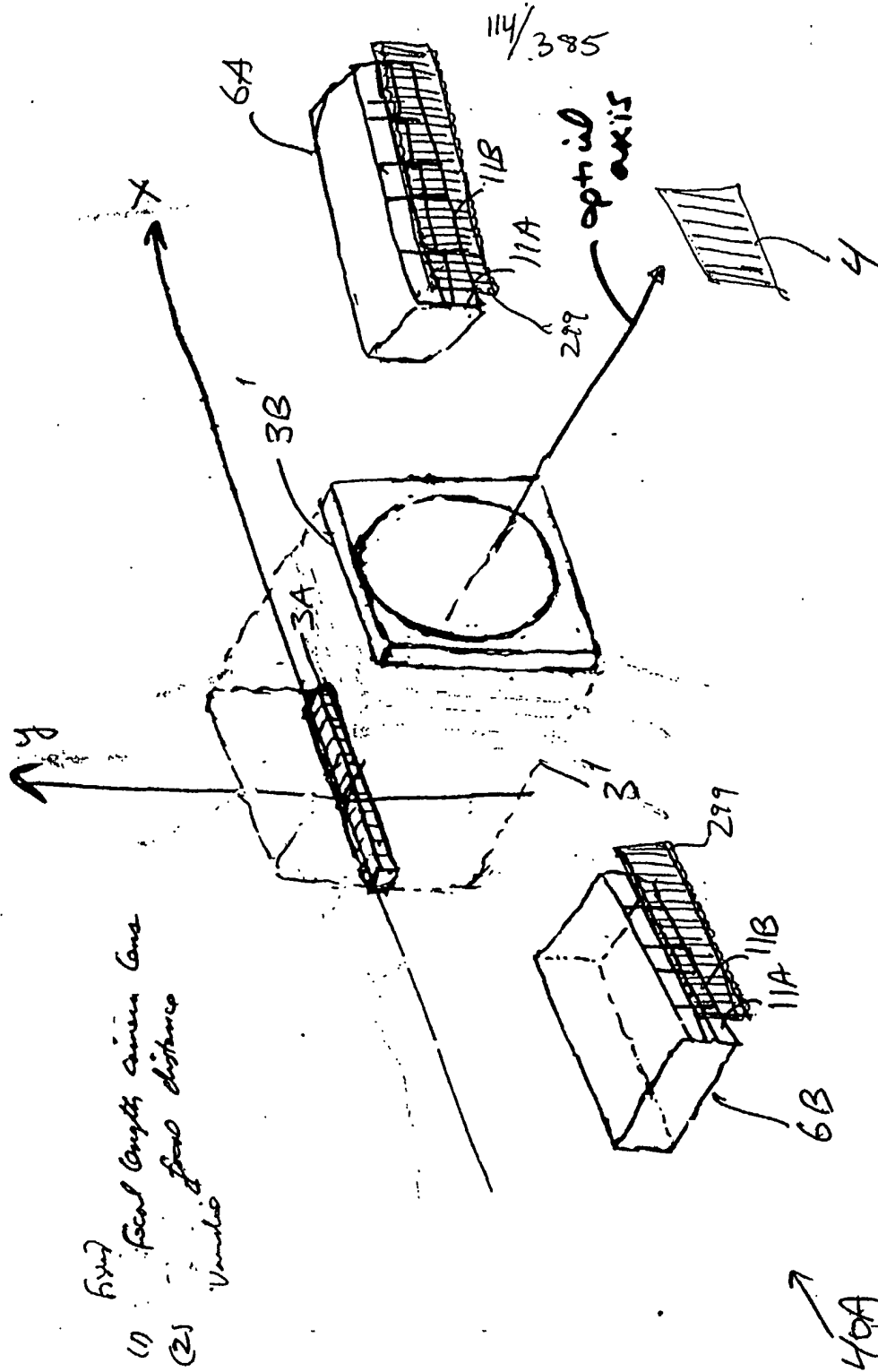


FIG. 2A

40





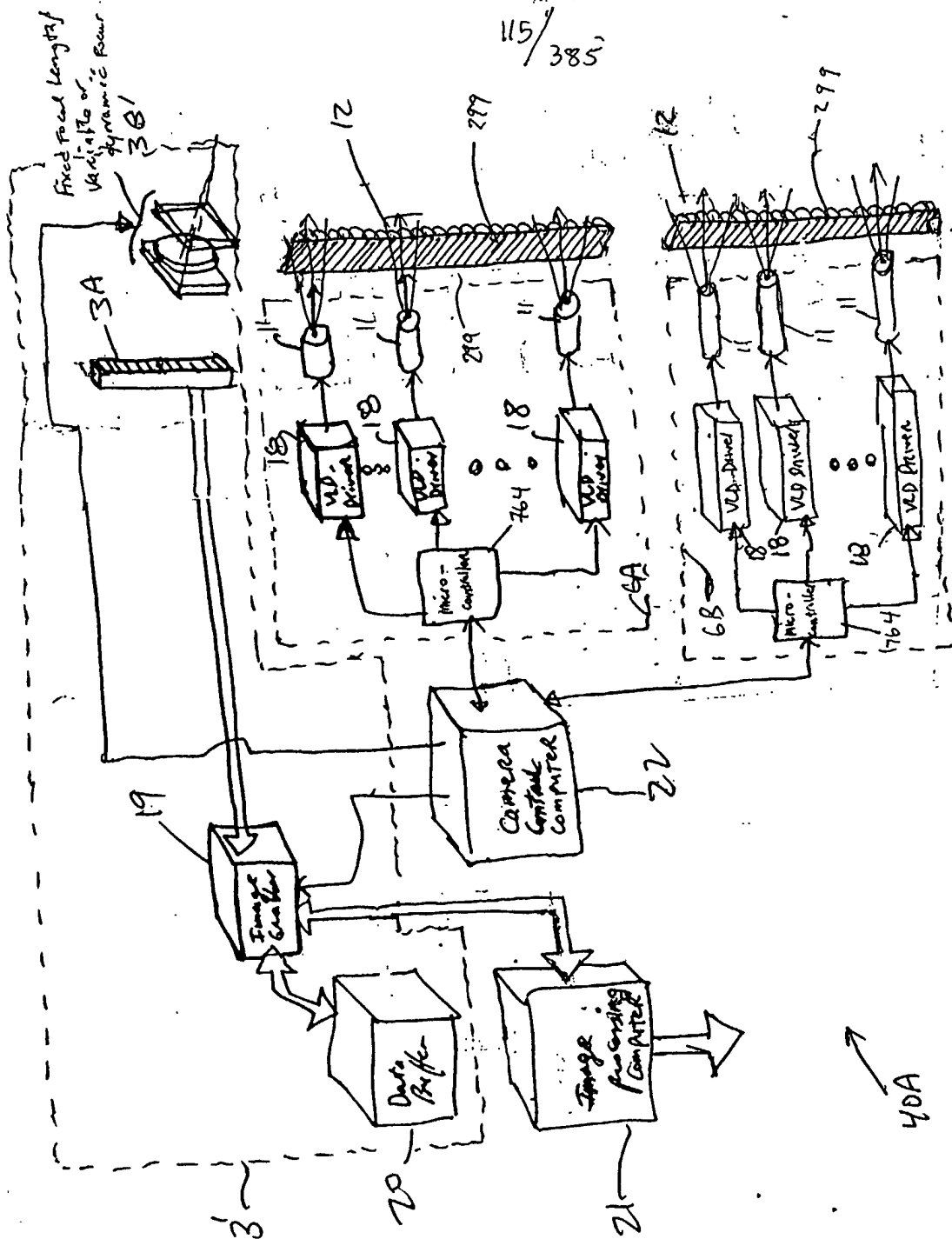


FIG. 2C1

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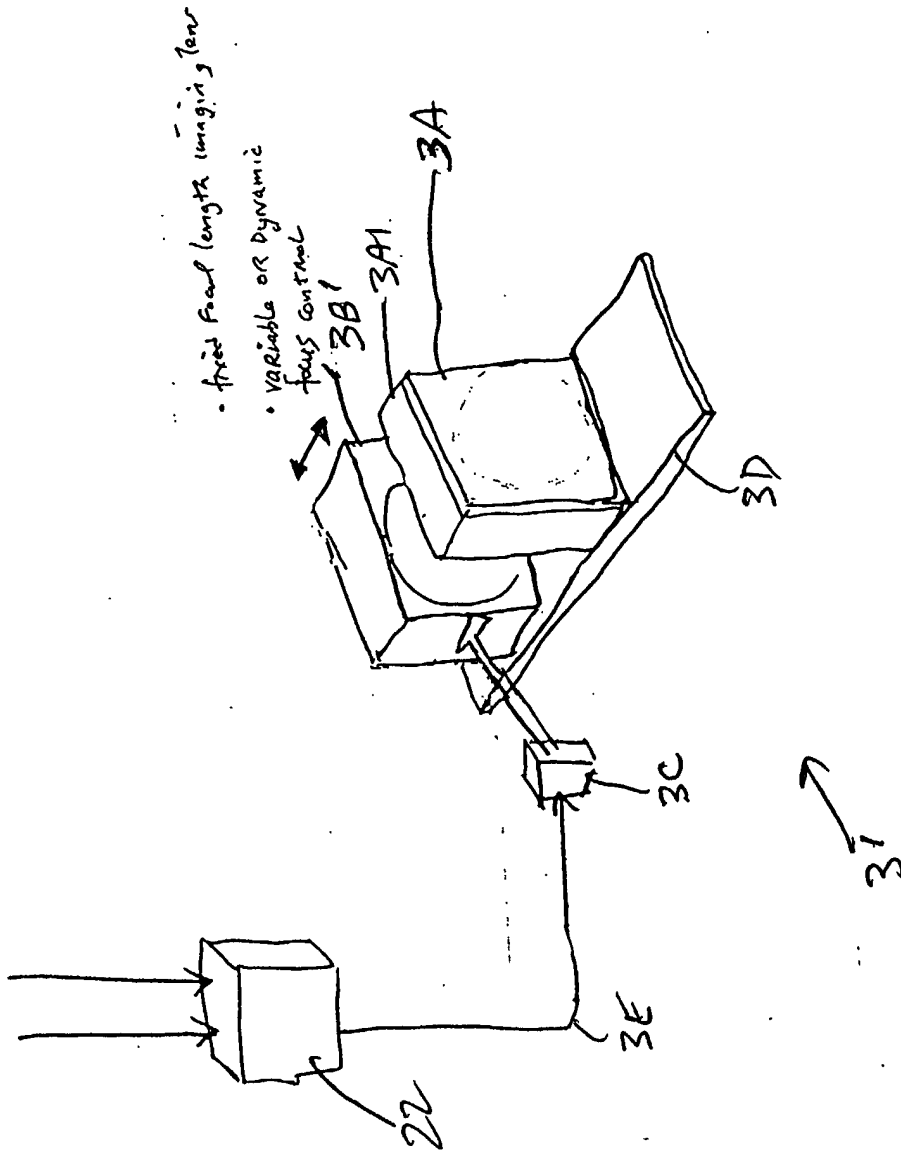
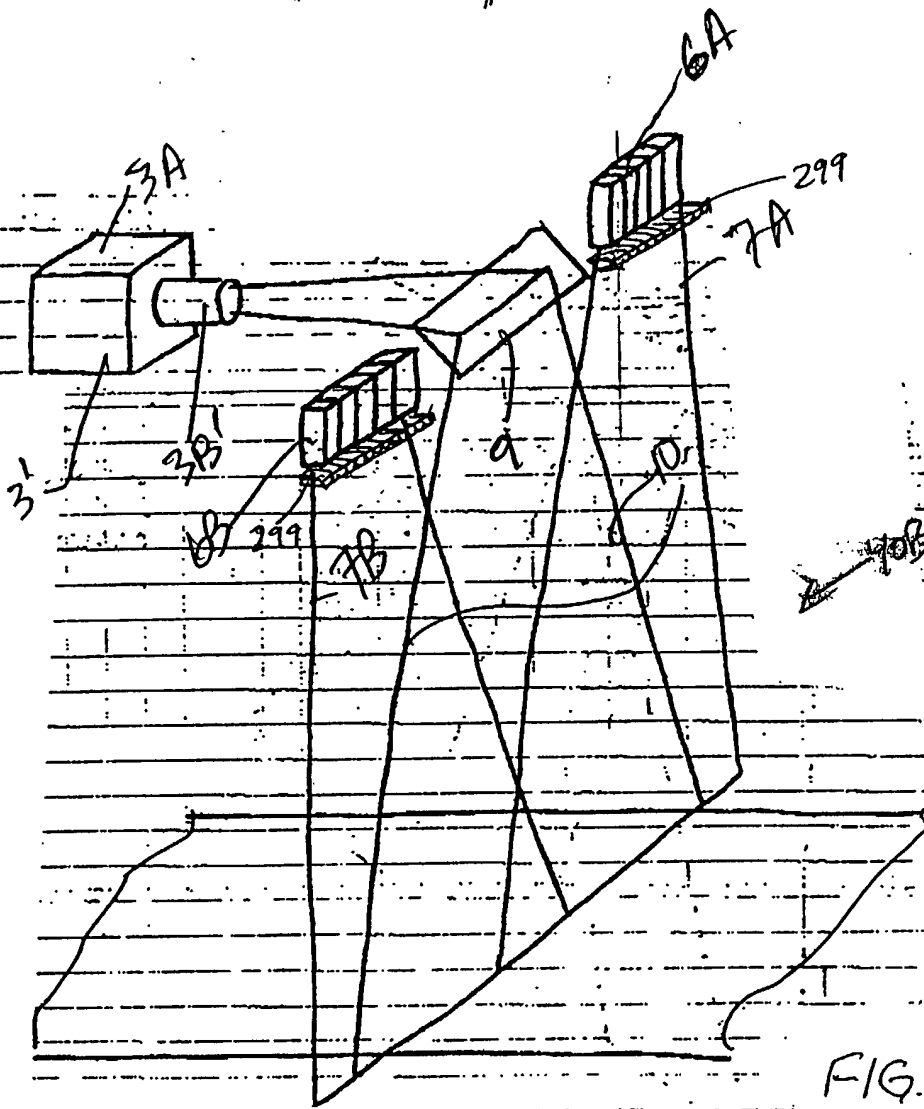


FIG. 2C2



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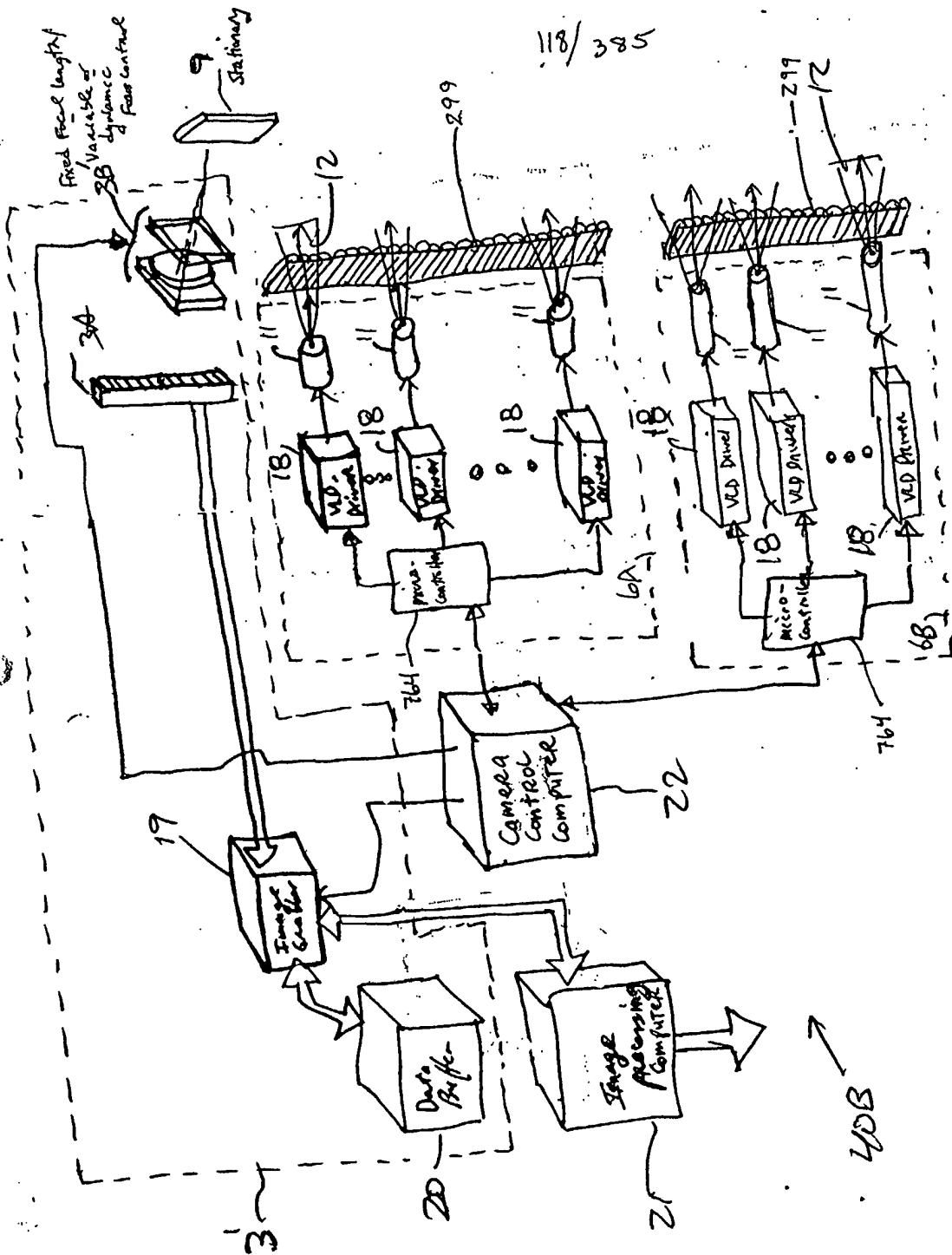
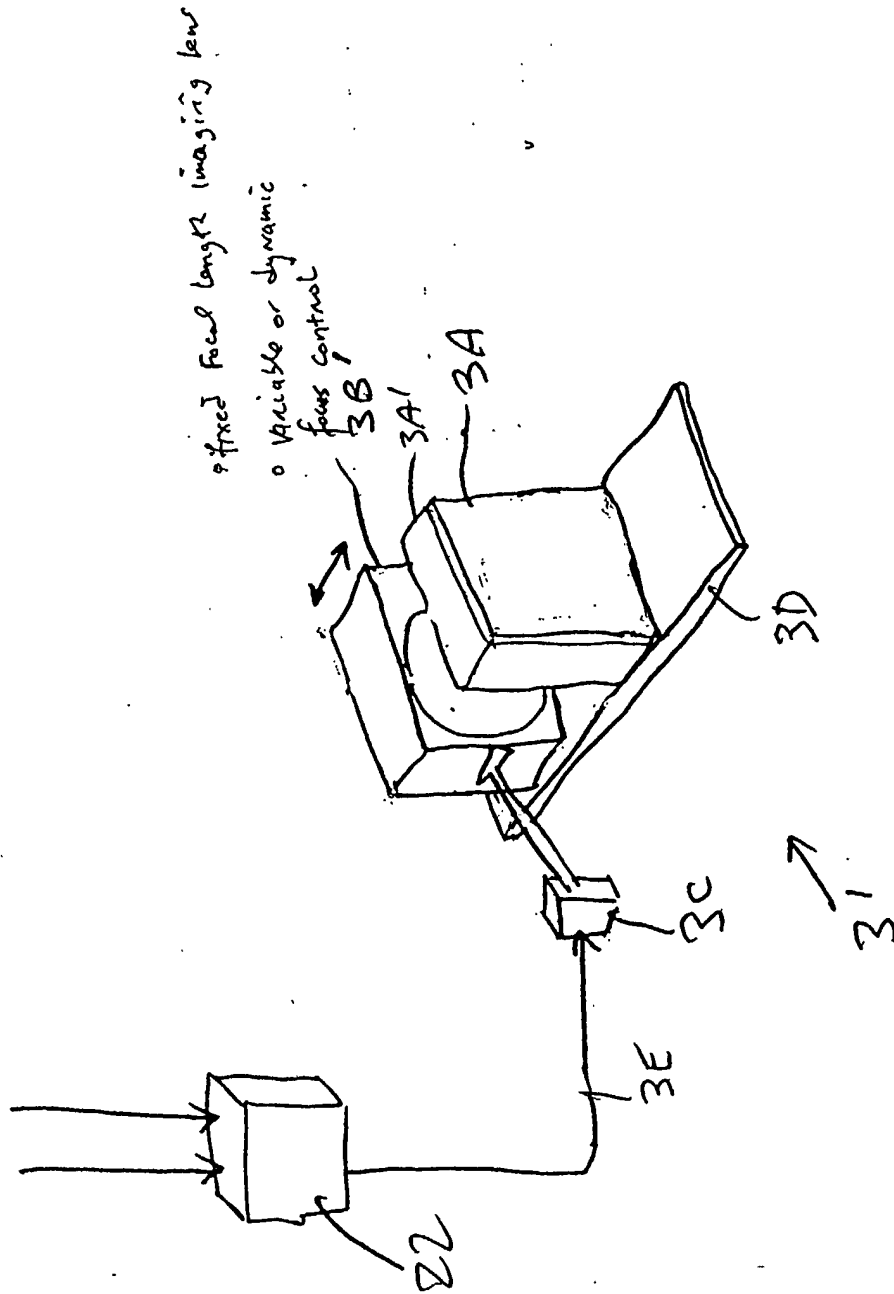


FIG. 2D2

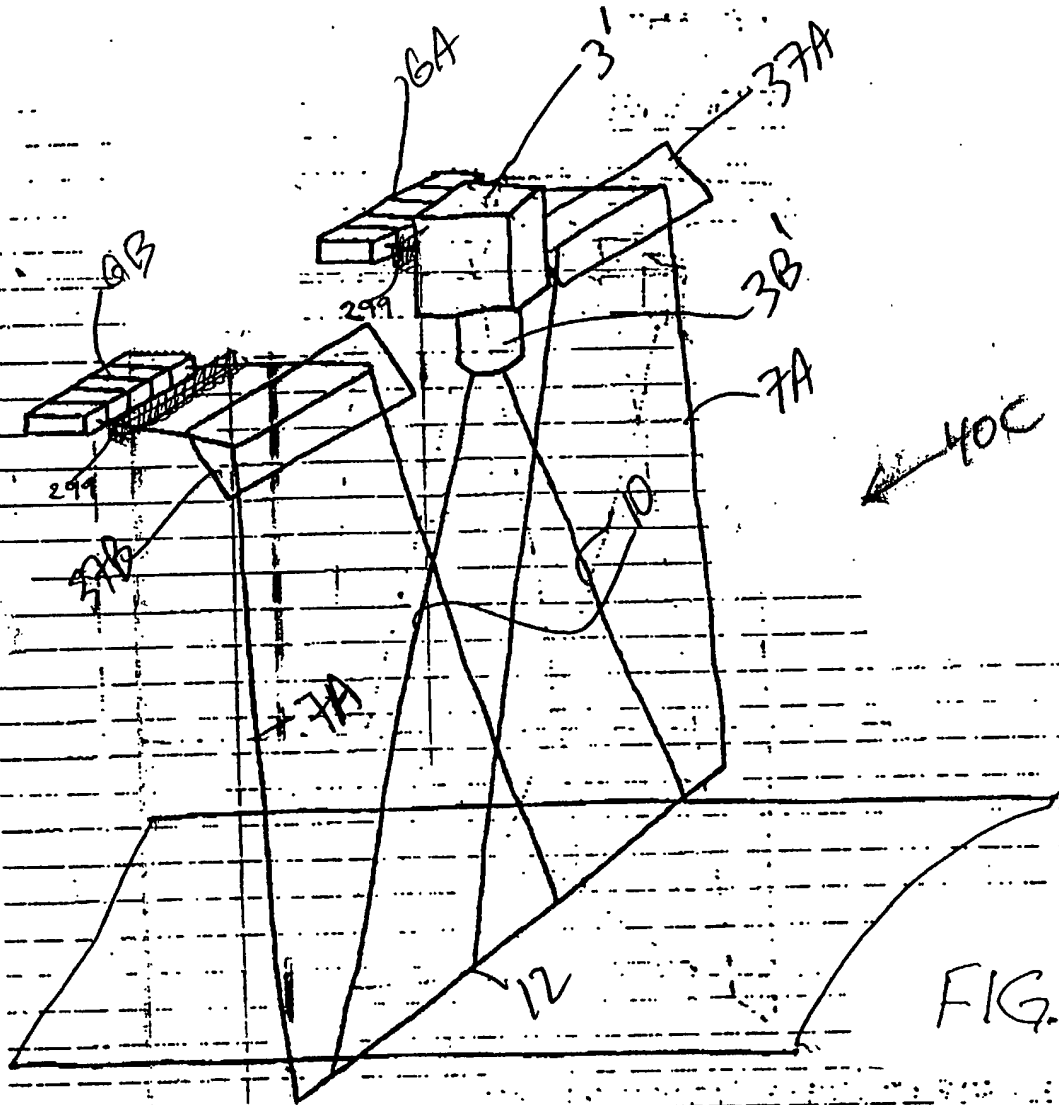
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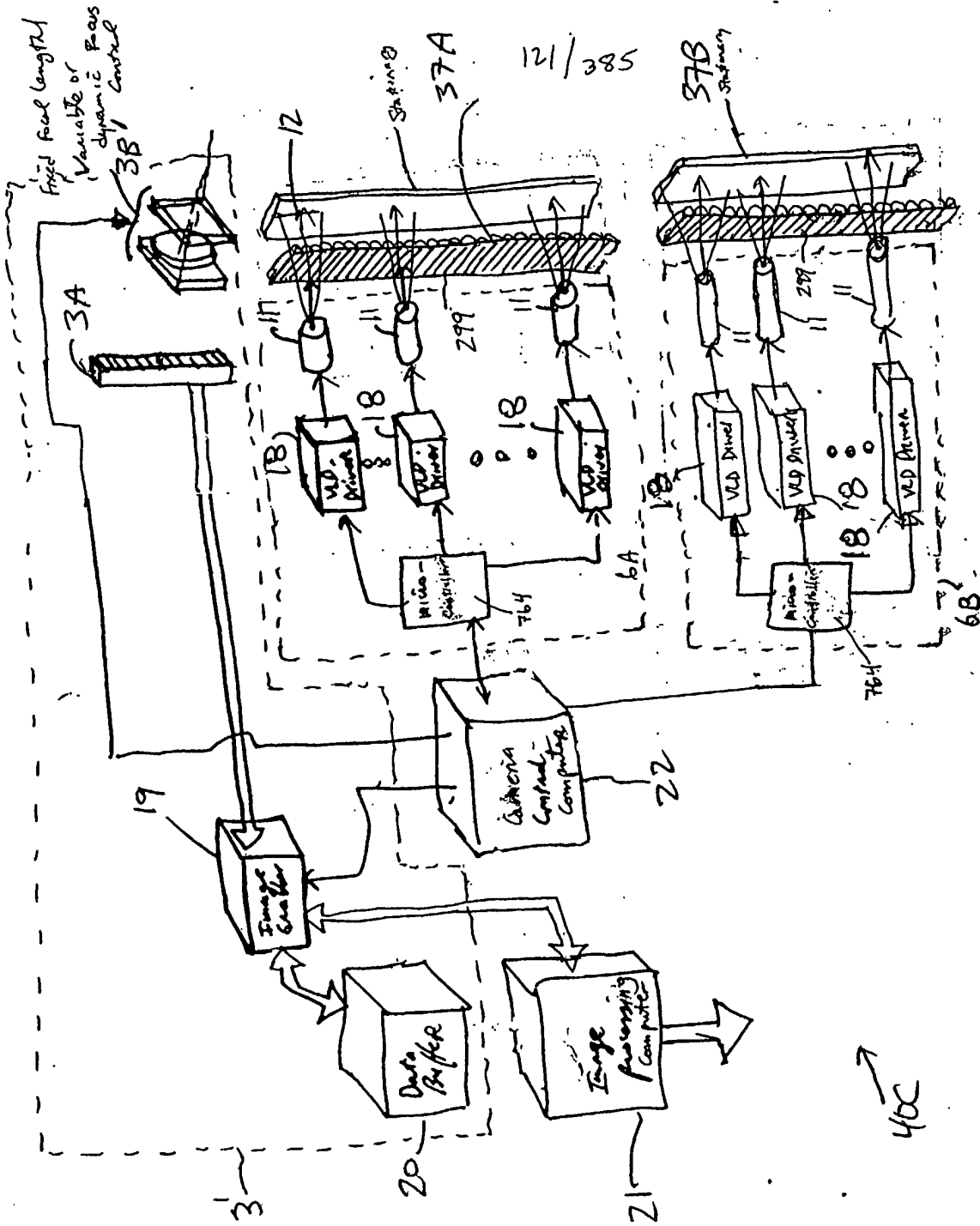


fixed focal length imaging lens  
 • Variable or dynamic  
 focus control

FIG. 2D3

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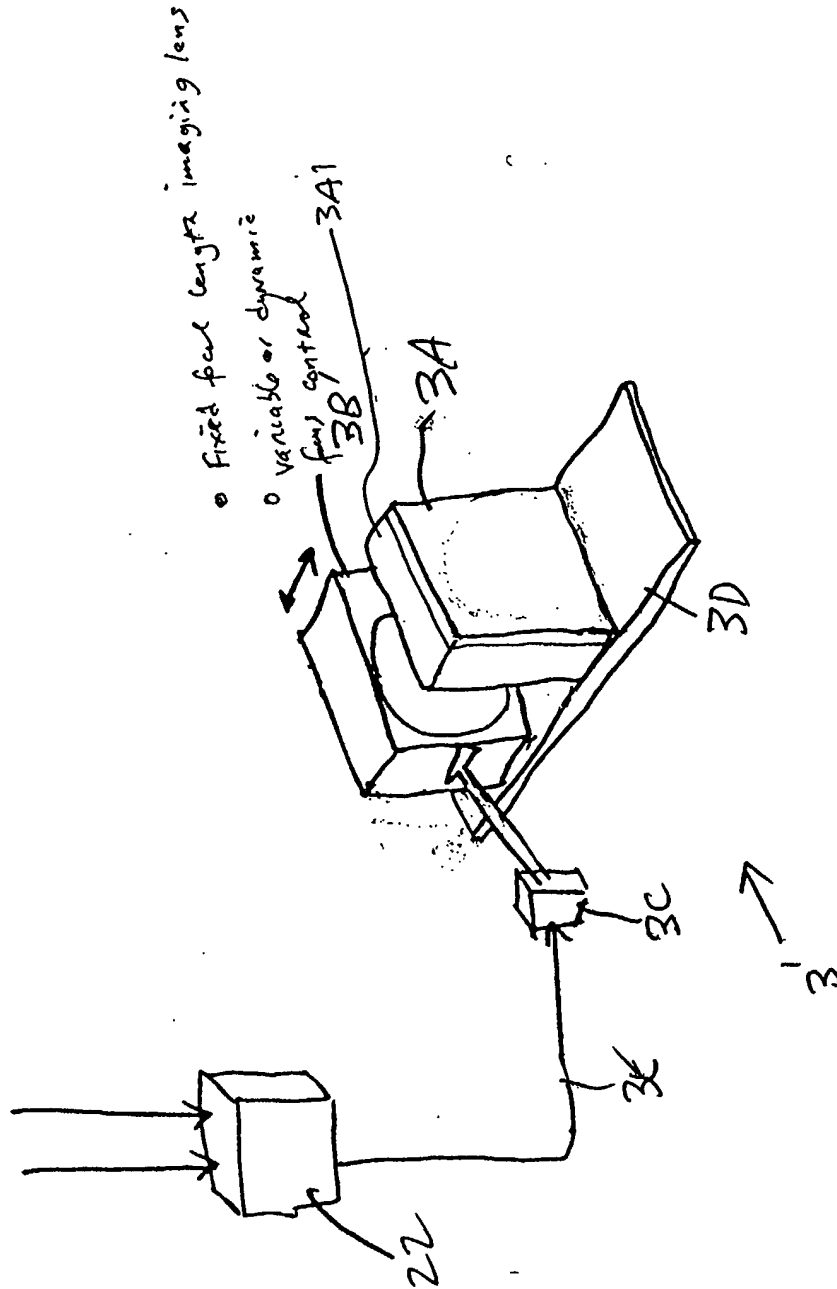
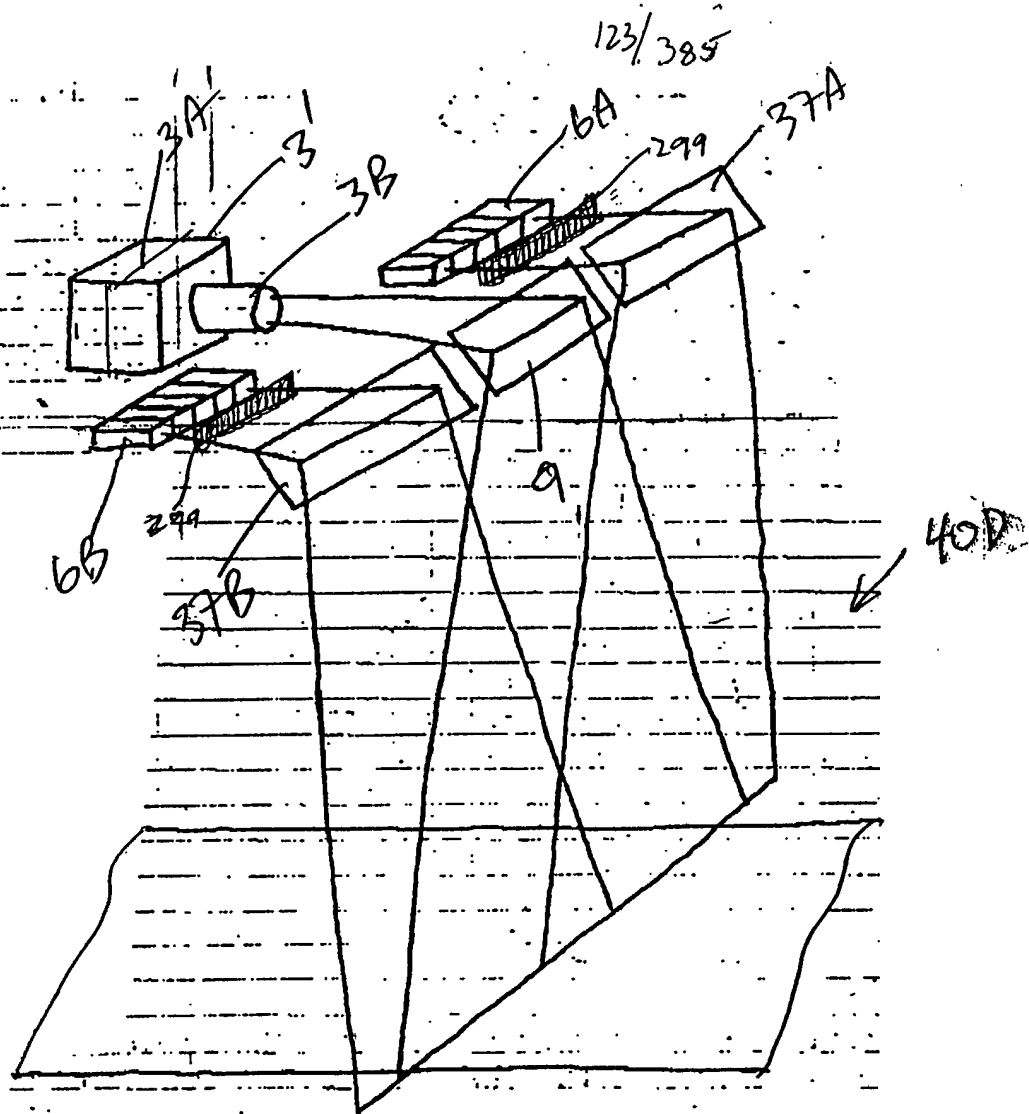


FIG. 2E3



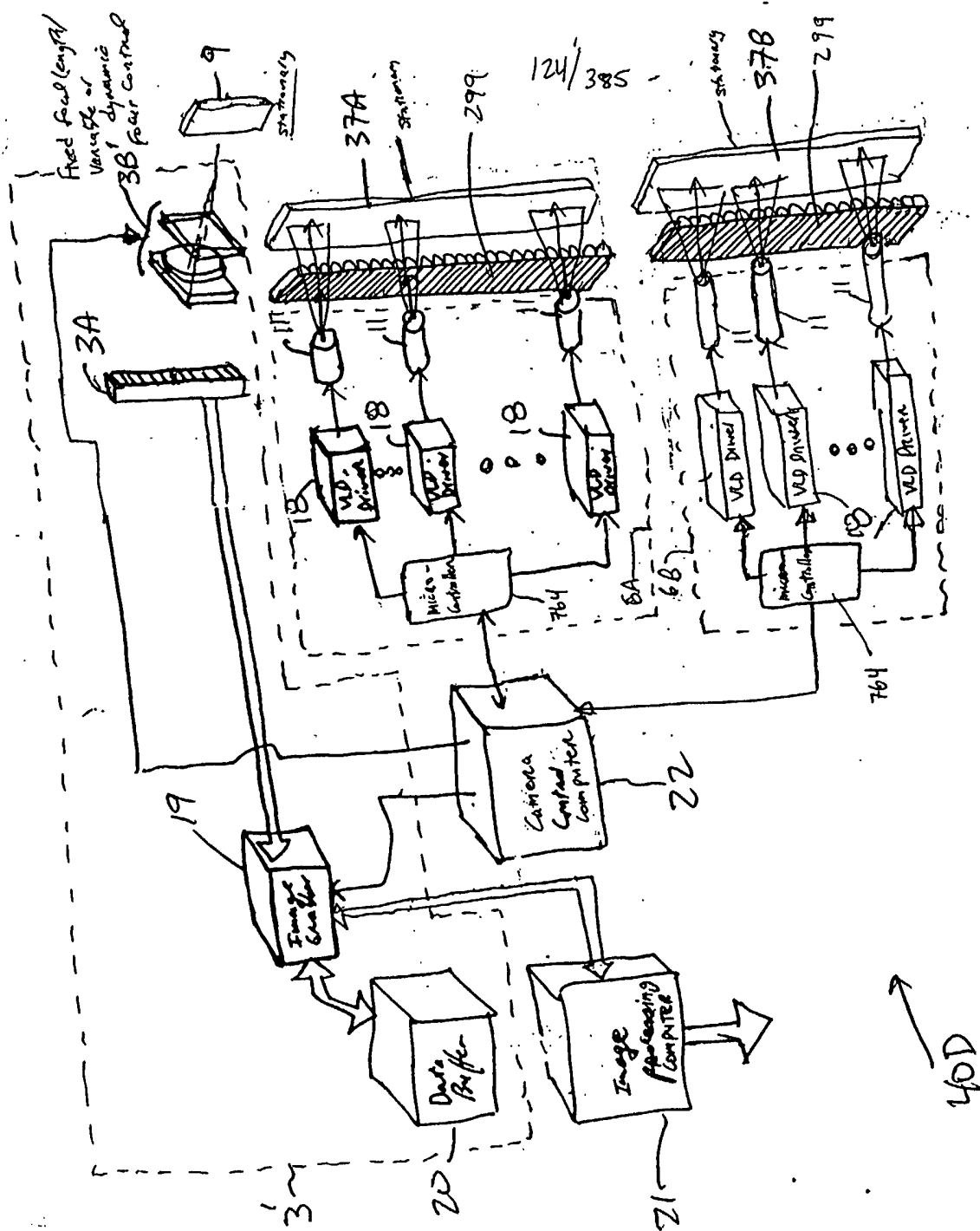


FIG 2FZ

40D



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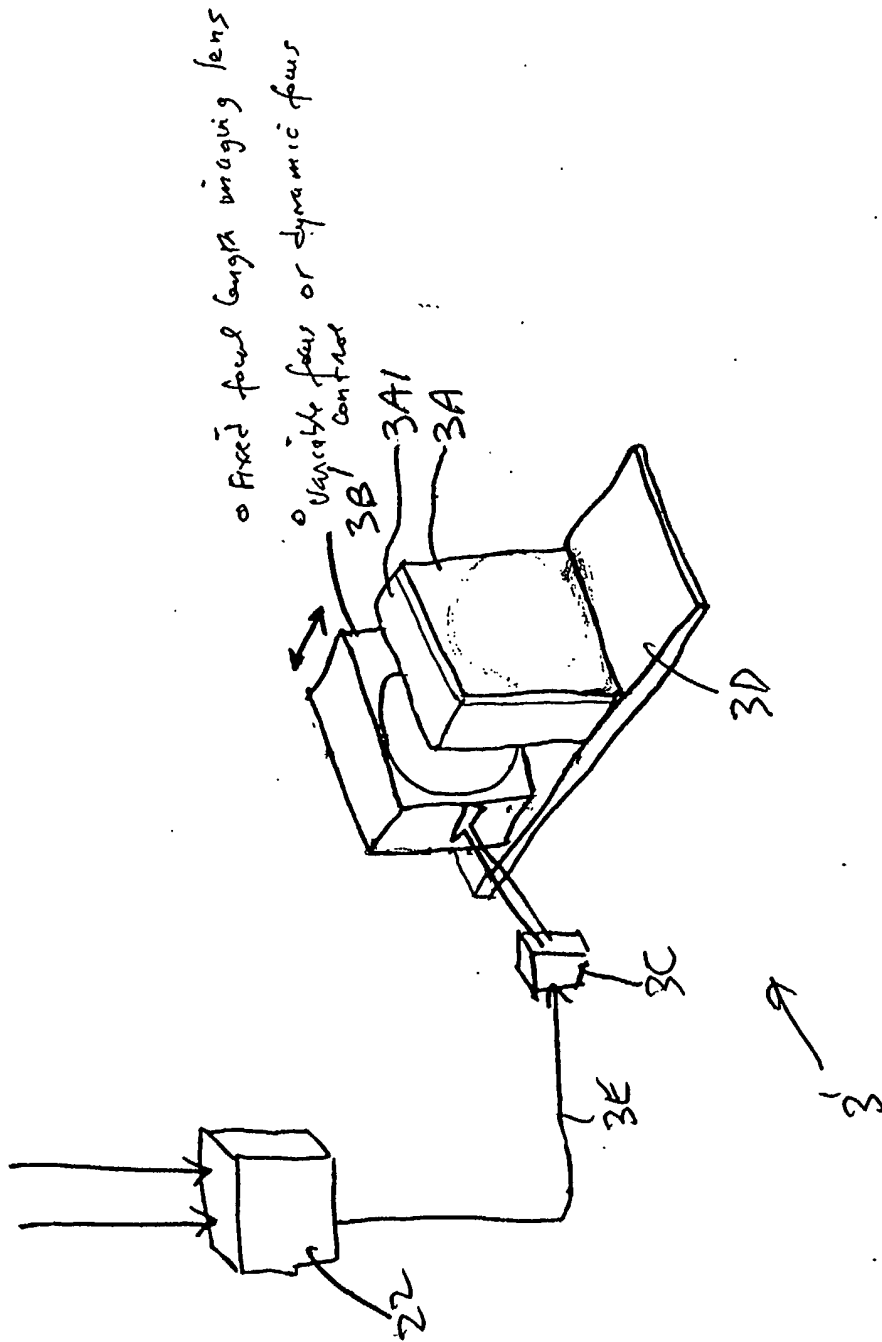


FIG. 2F3

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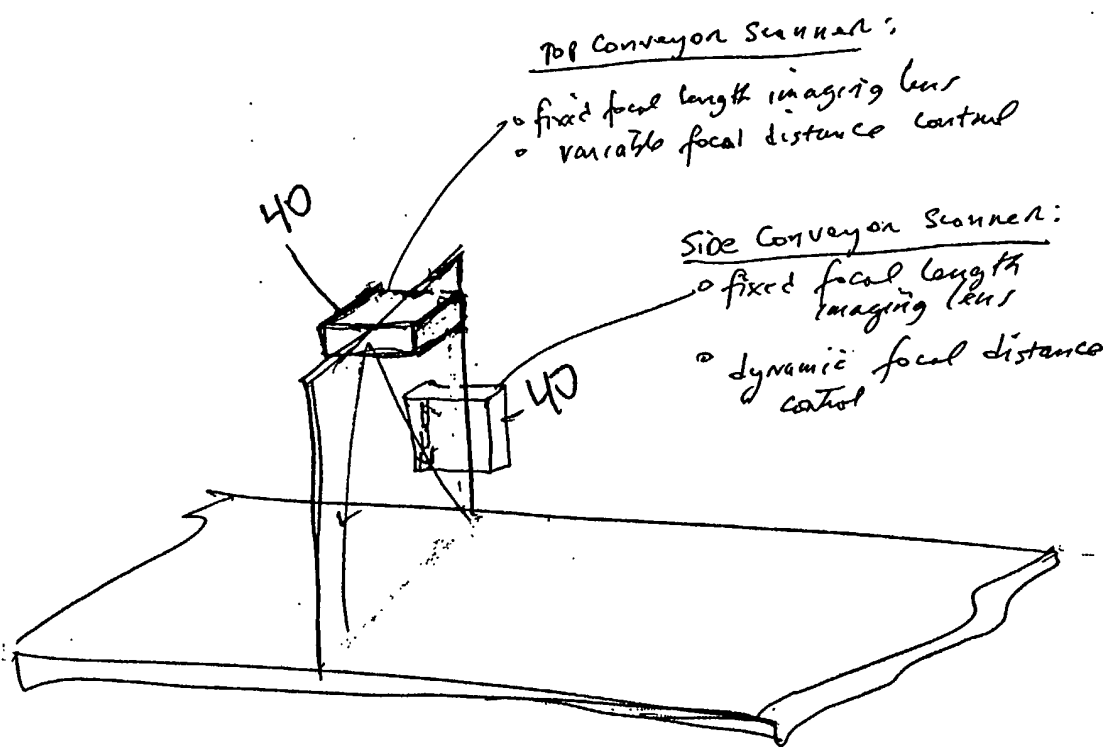


FIG. 2G

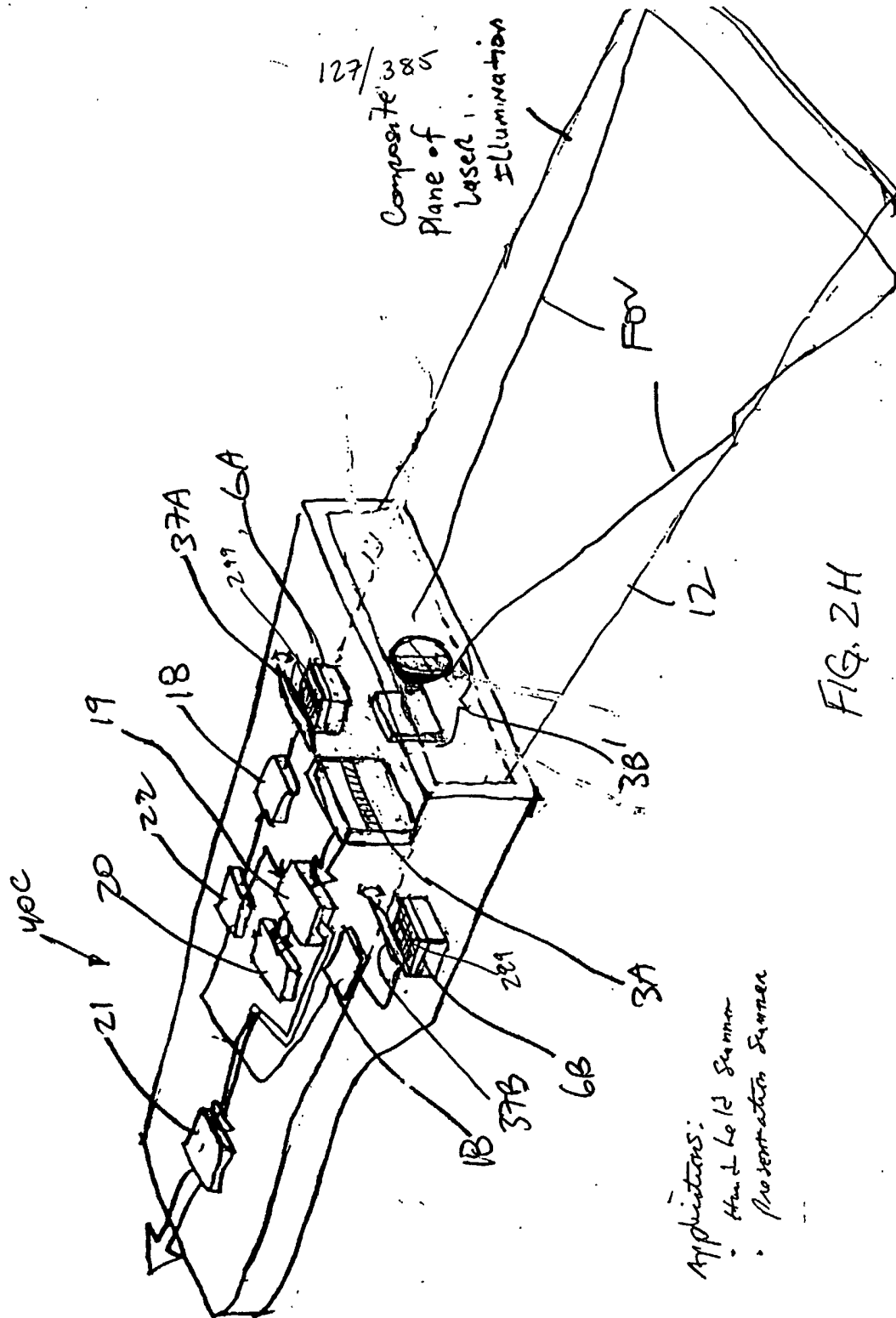


FIG. 2H

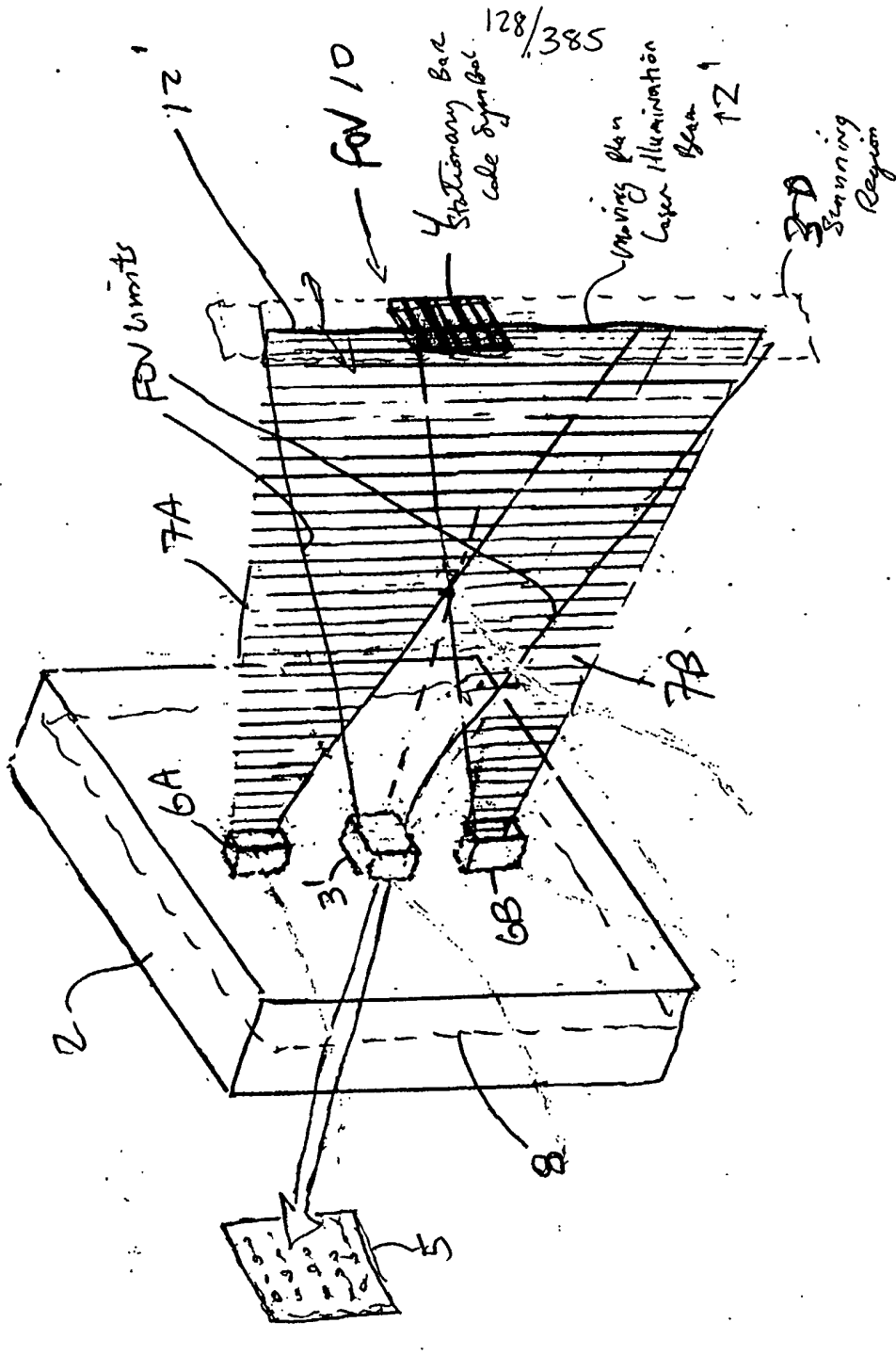


FIG. 2II



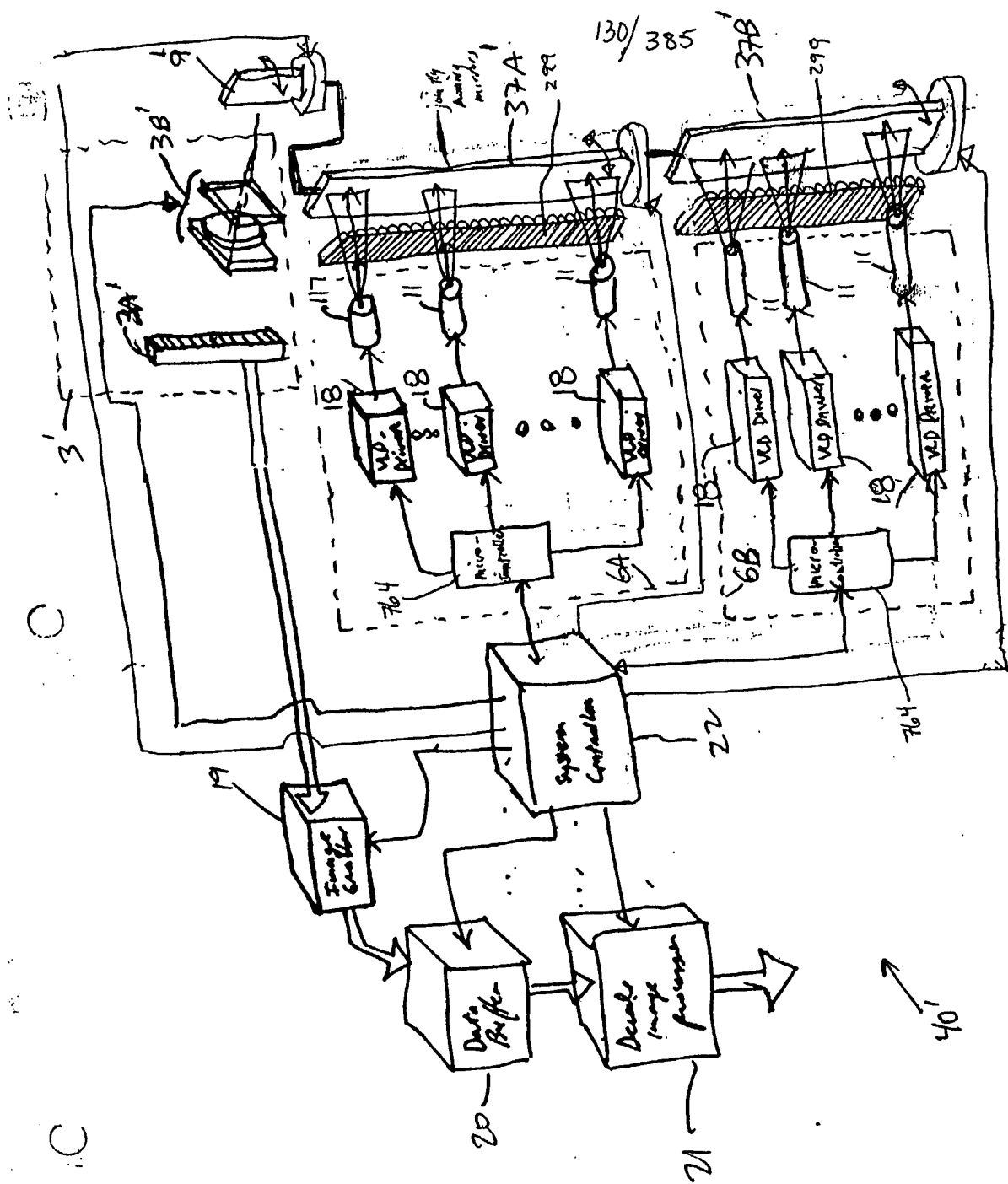


FIG. 2 I 3

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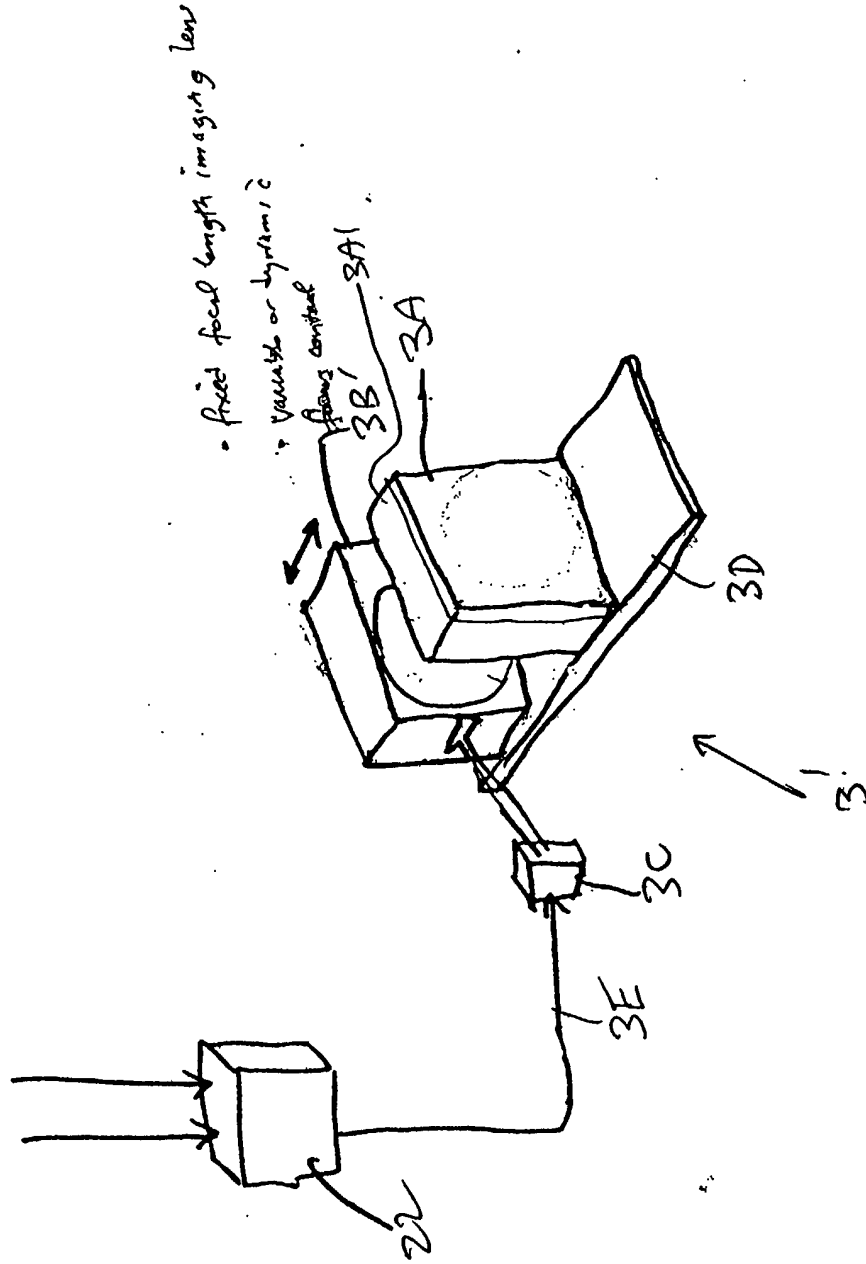


FIG. 2I4

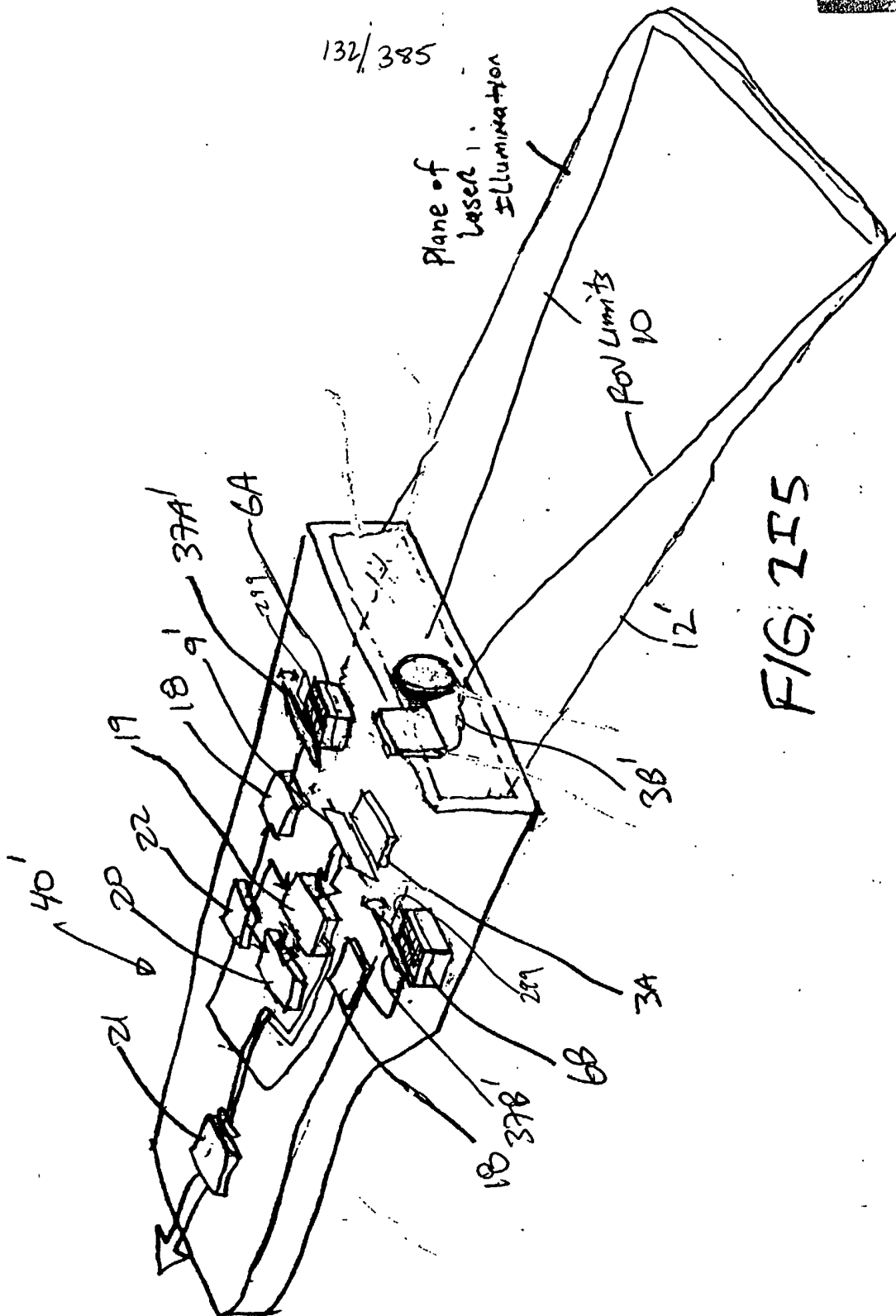


FIG. 215



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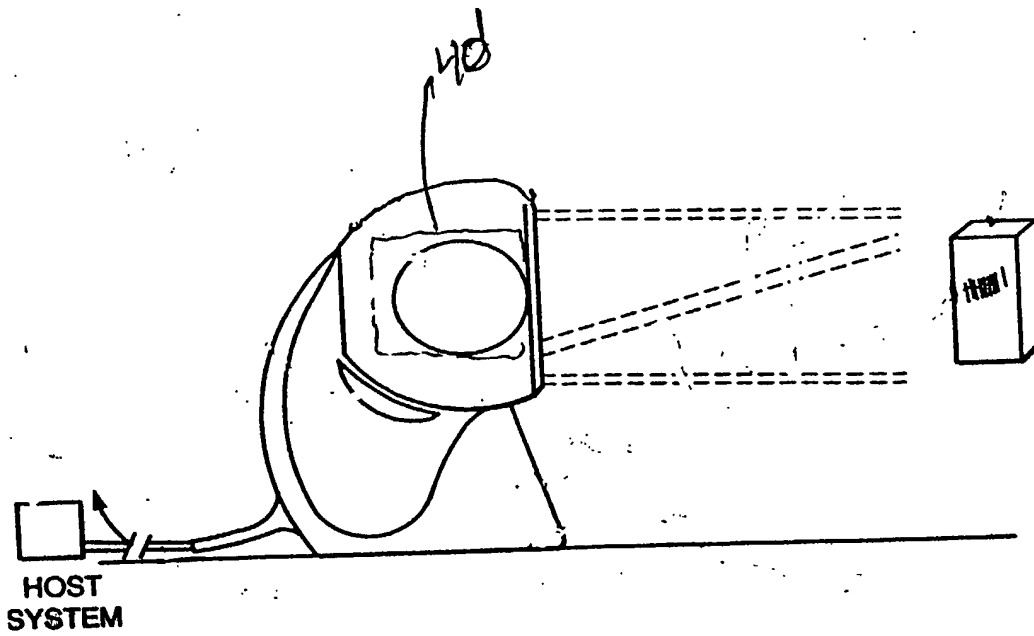


FIG. 2I6

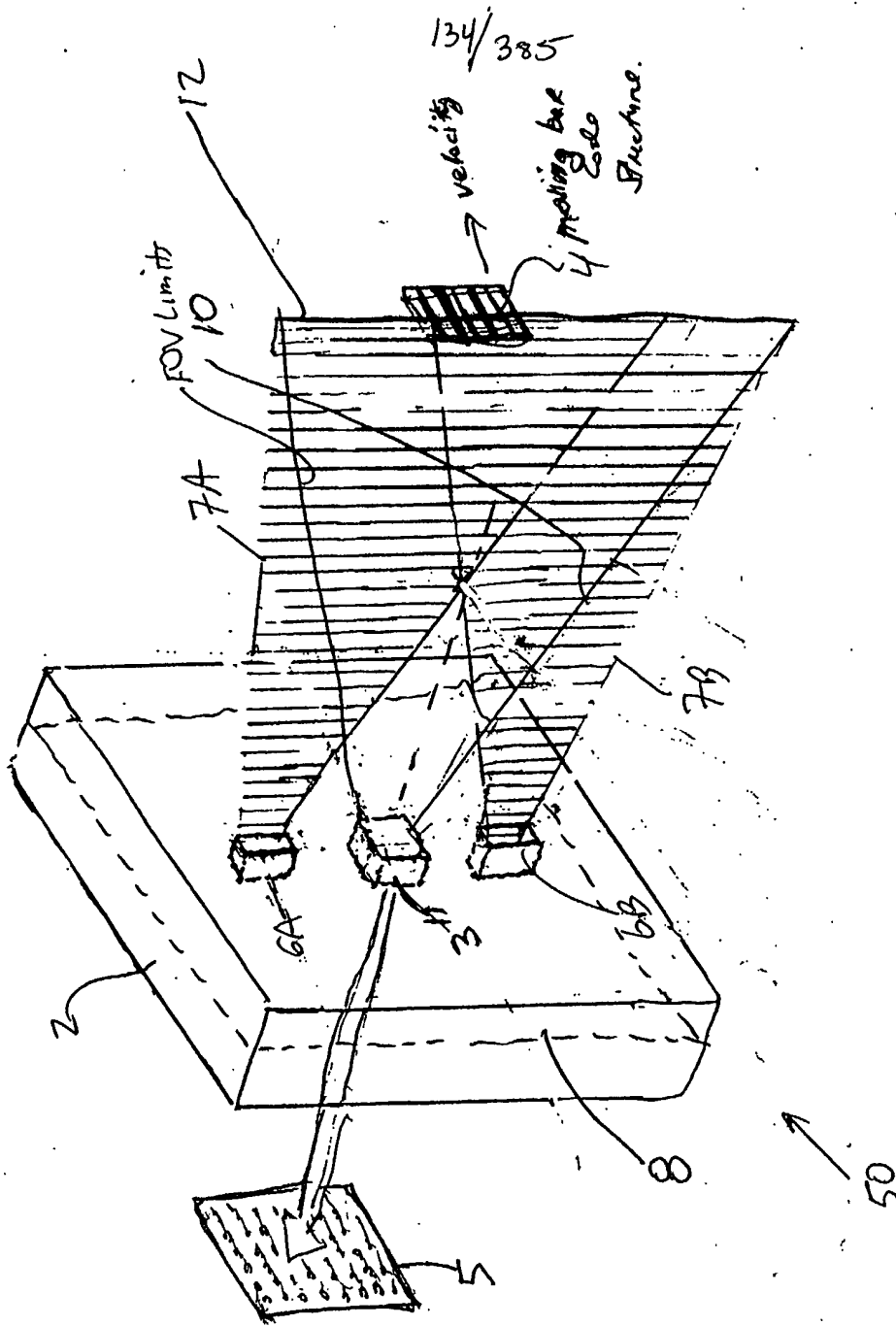


FIG 3A

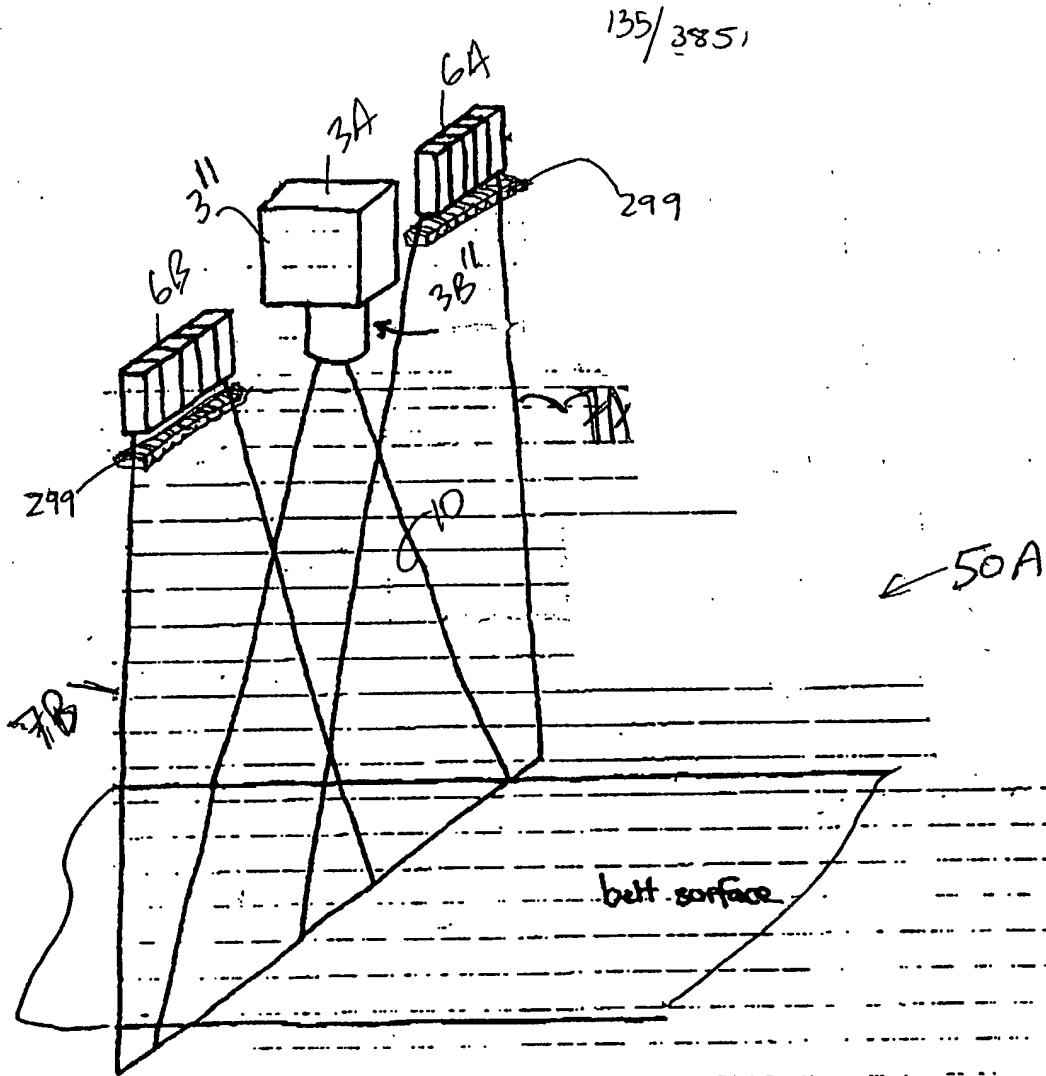


FIG. 3B1

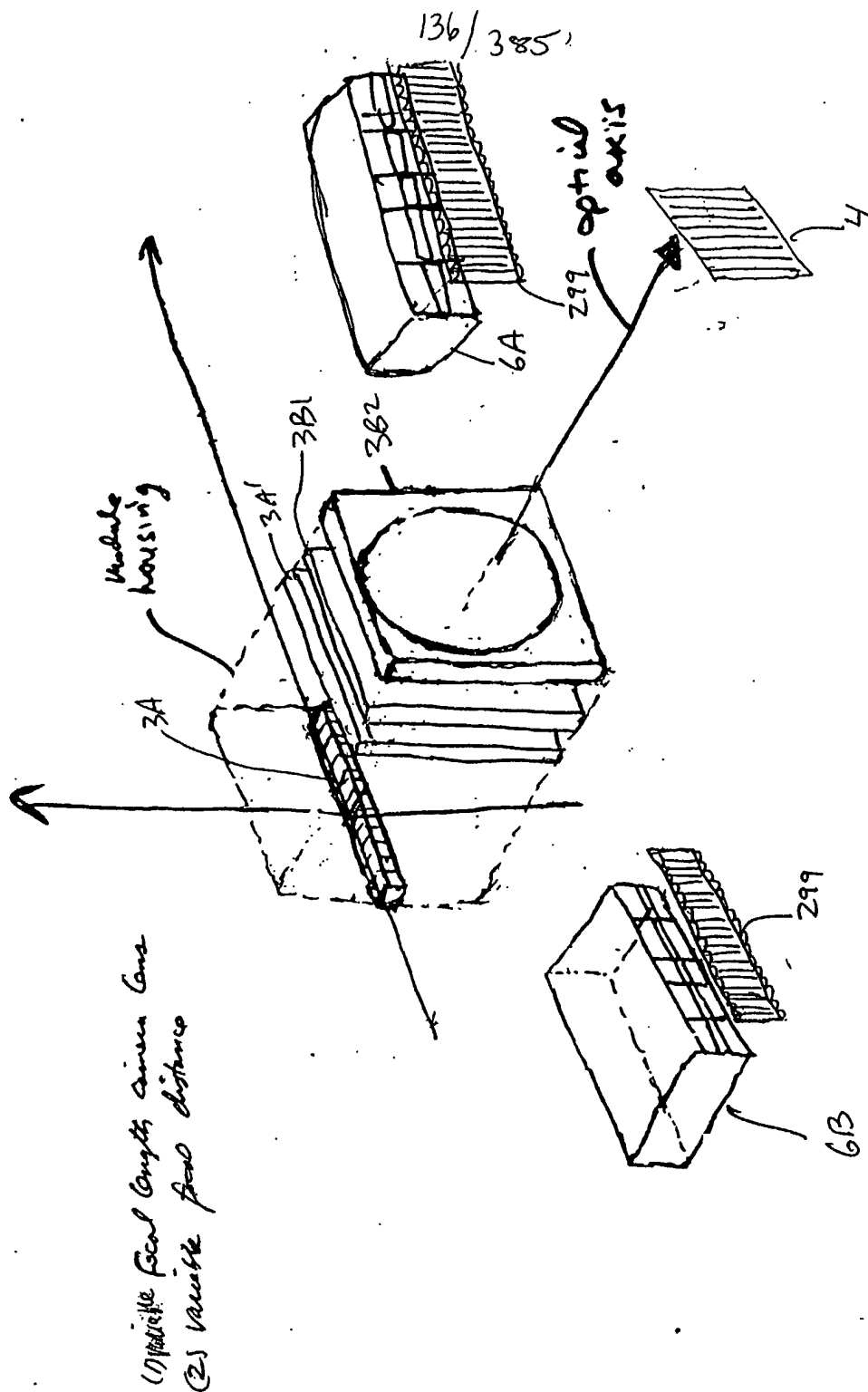
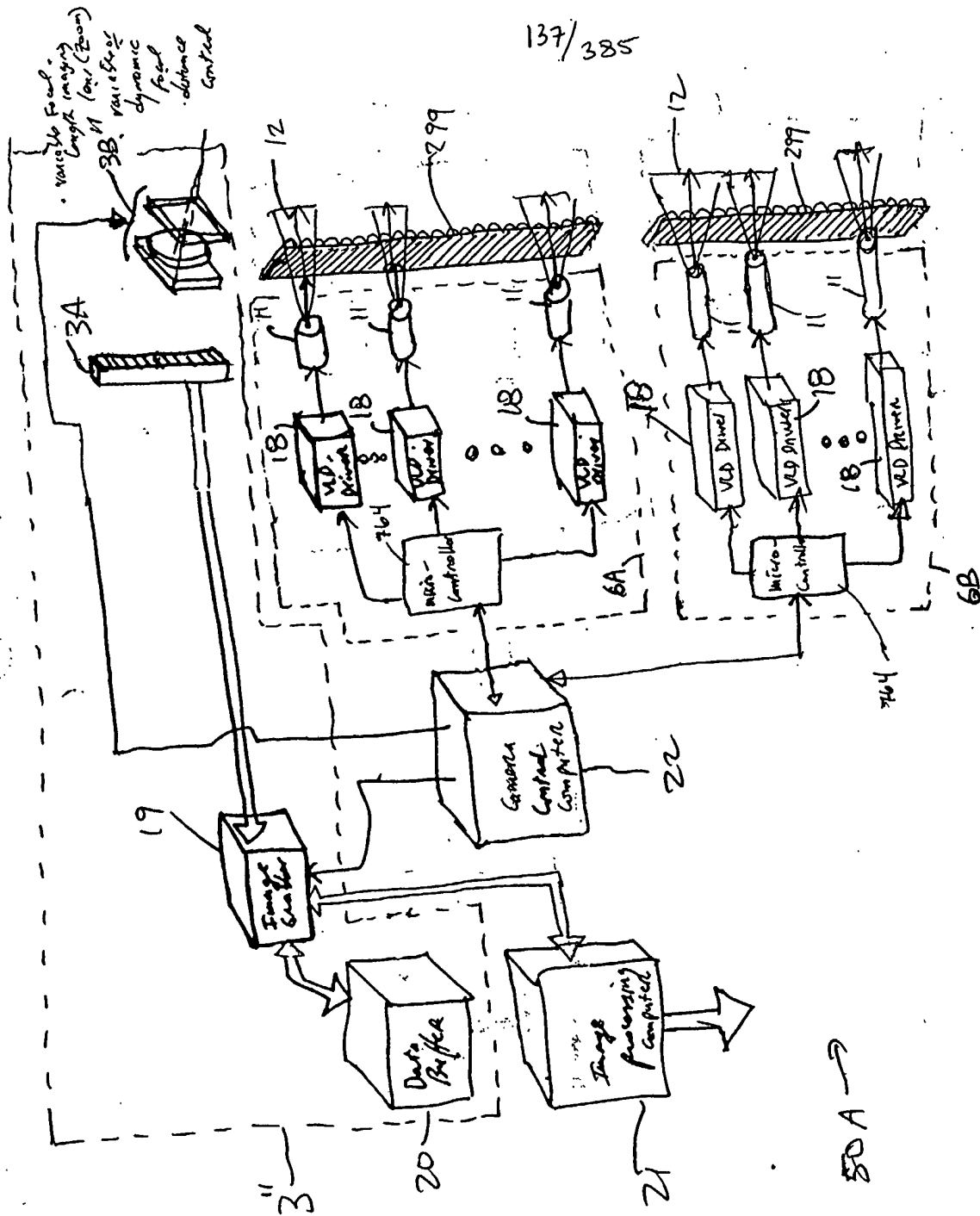


FIG. 3B2

$$137/385$$


50A ↑

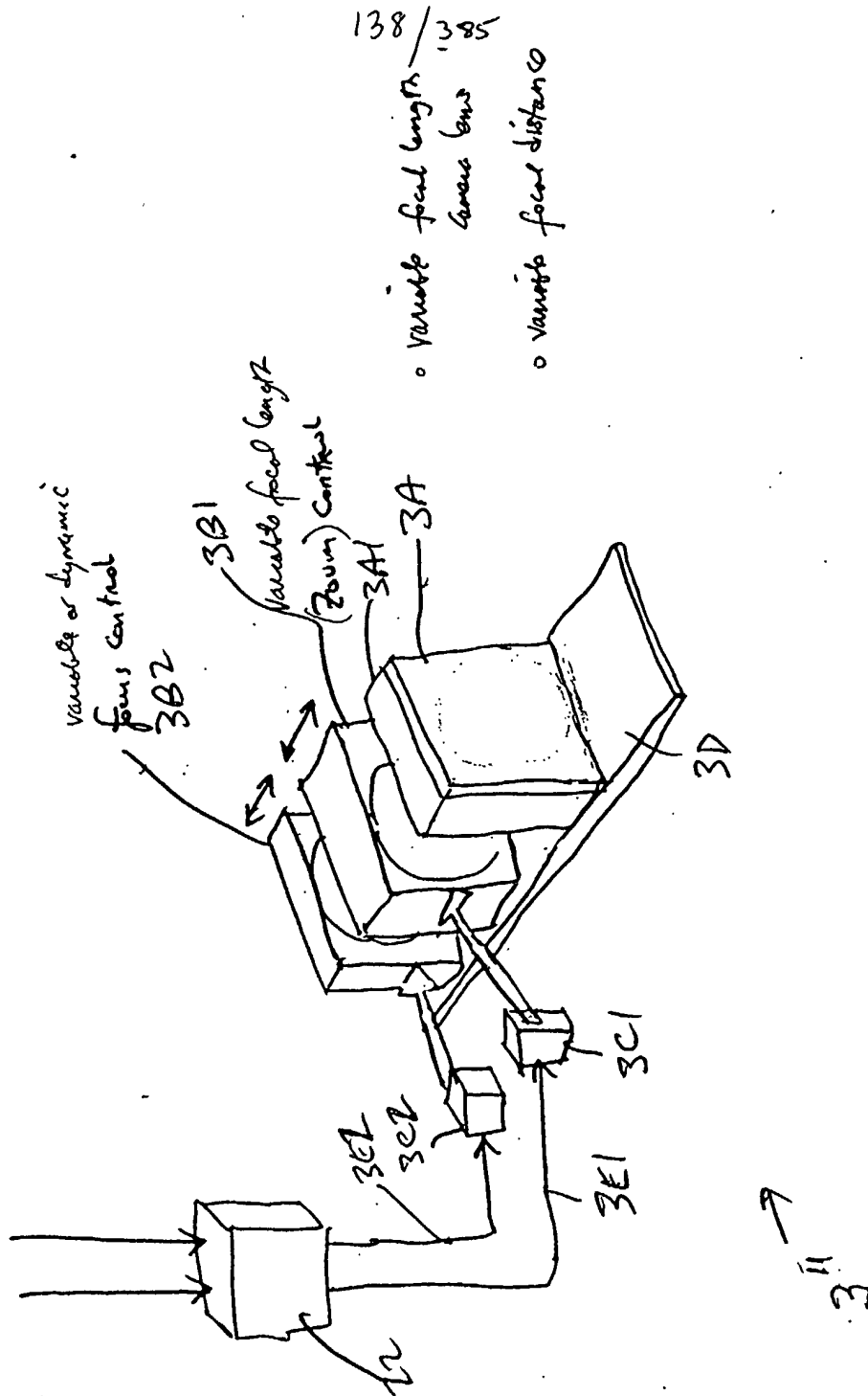
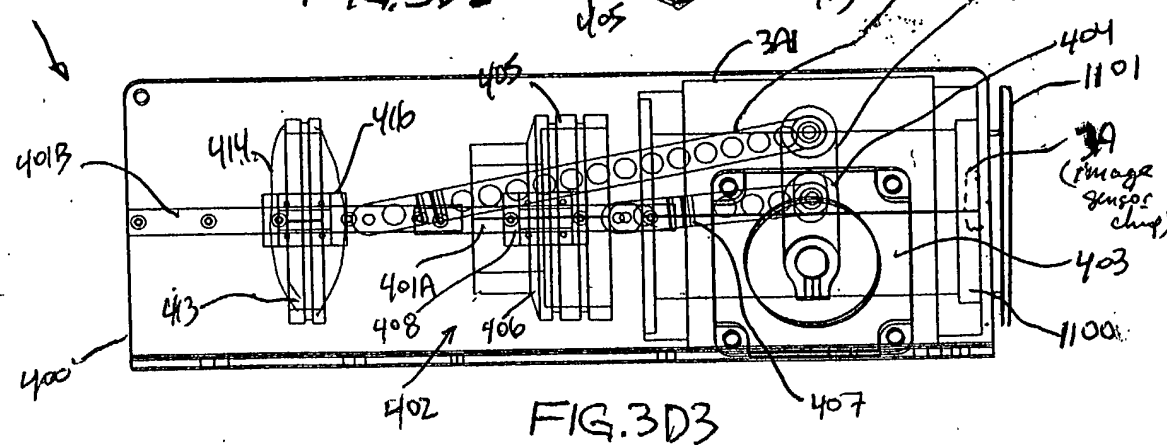
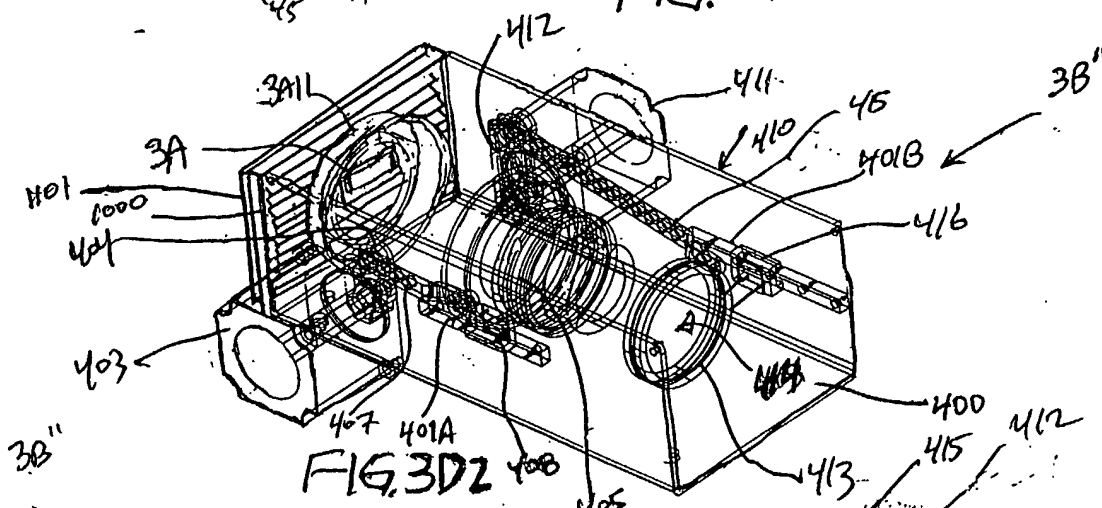
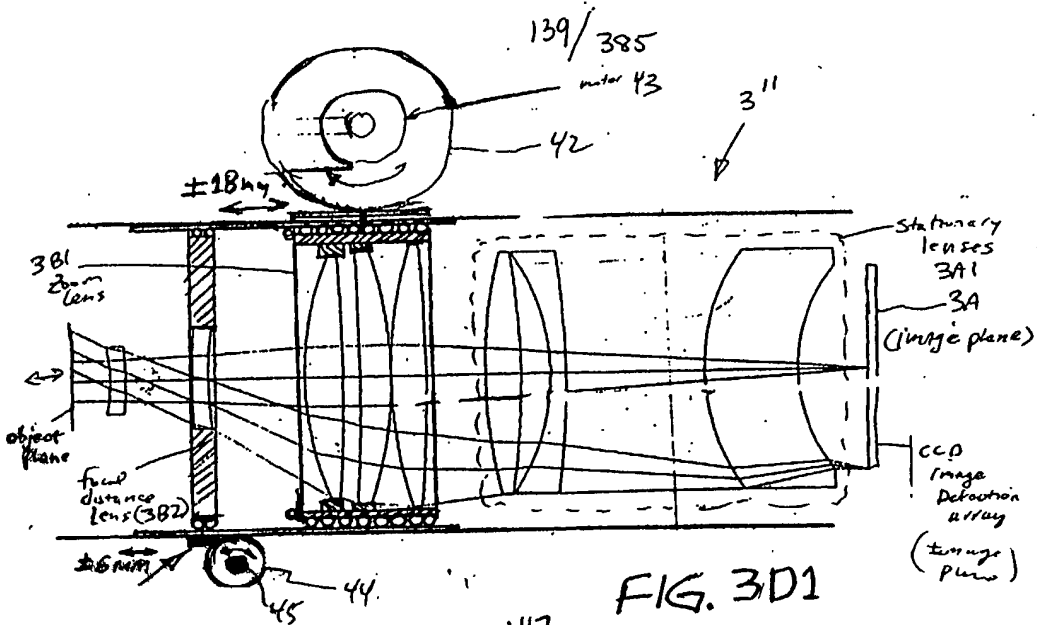


FIG. 3CZ



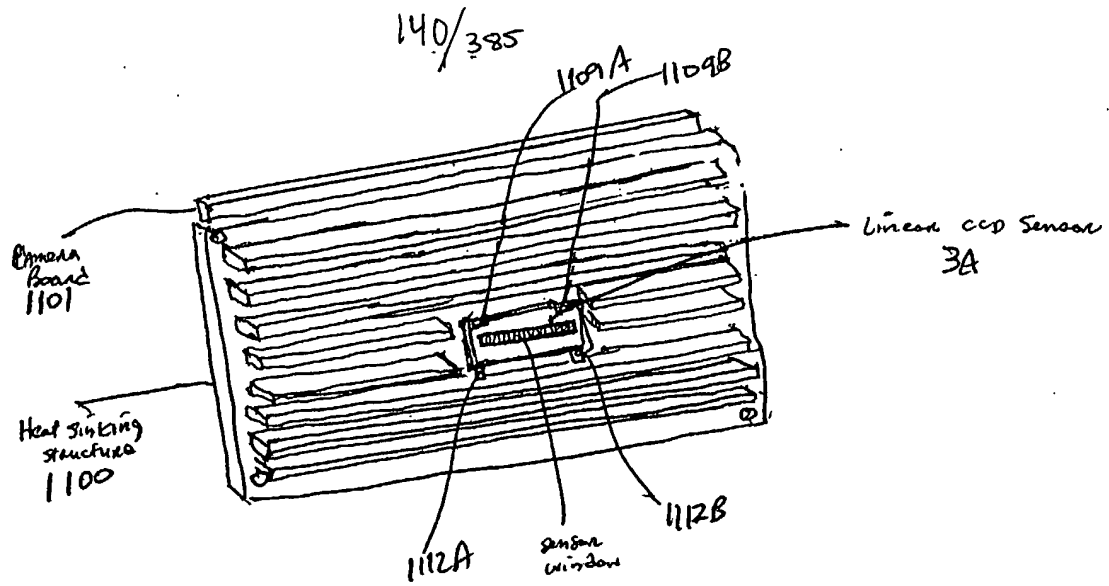


FIG. 3D4

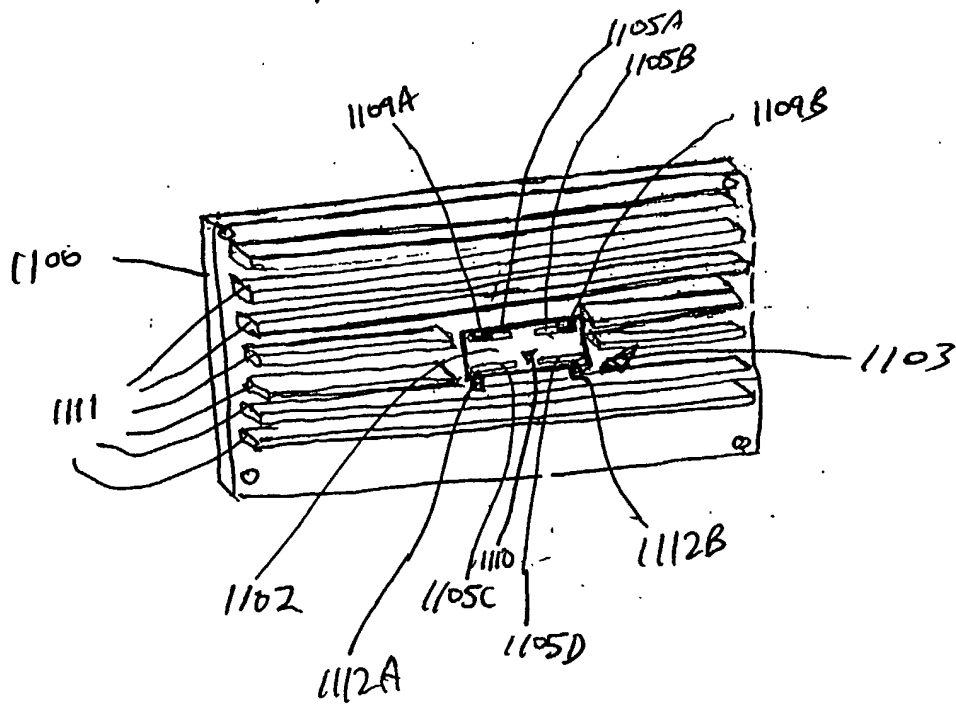


FIG. 3D5



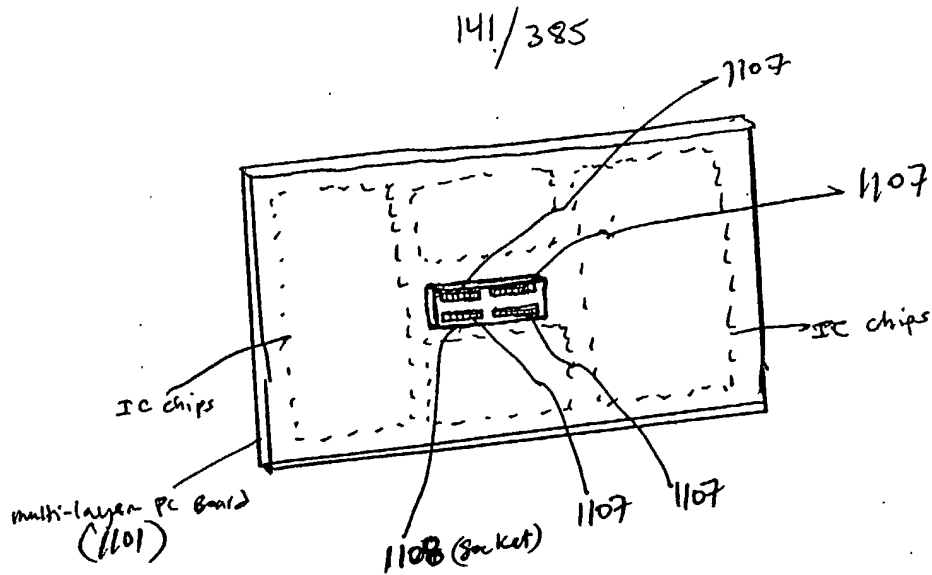


FIG. 3D6

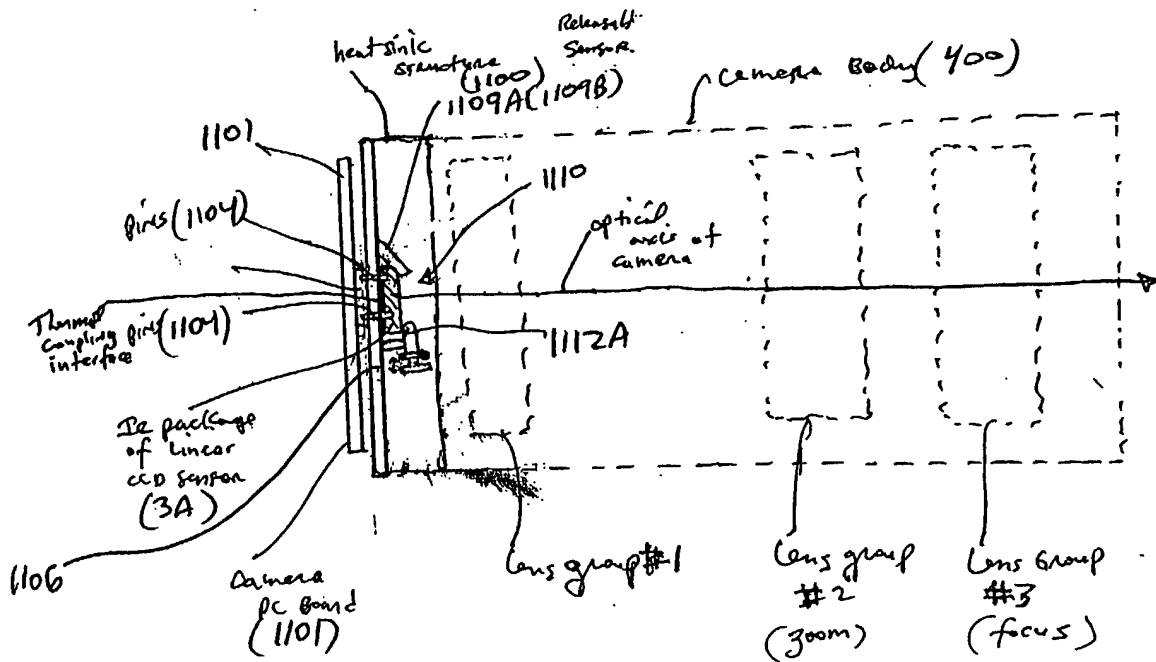
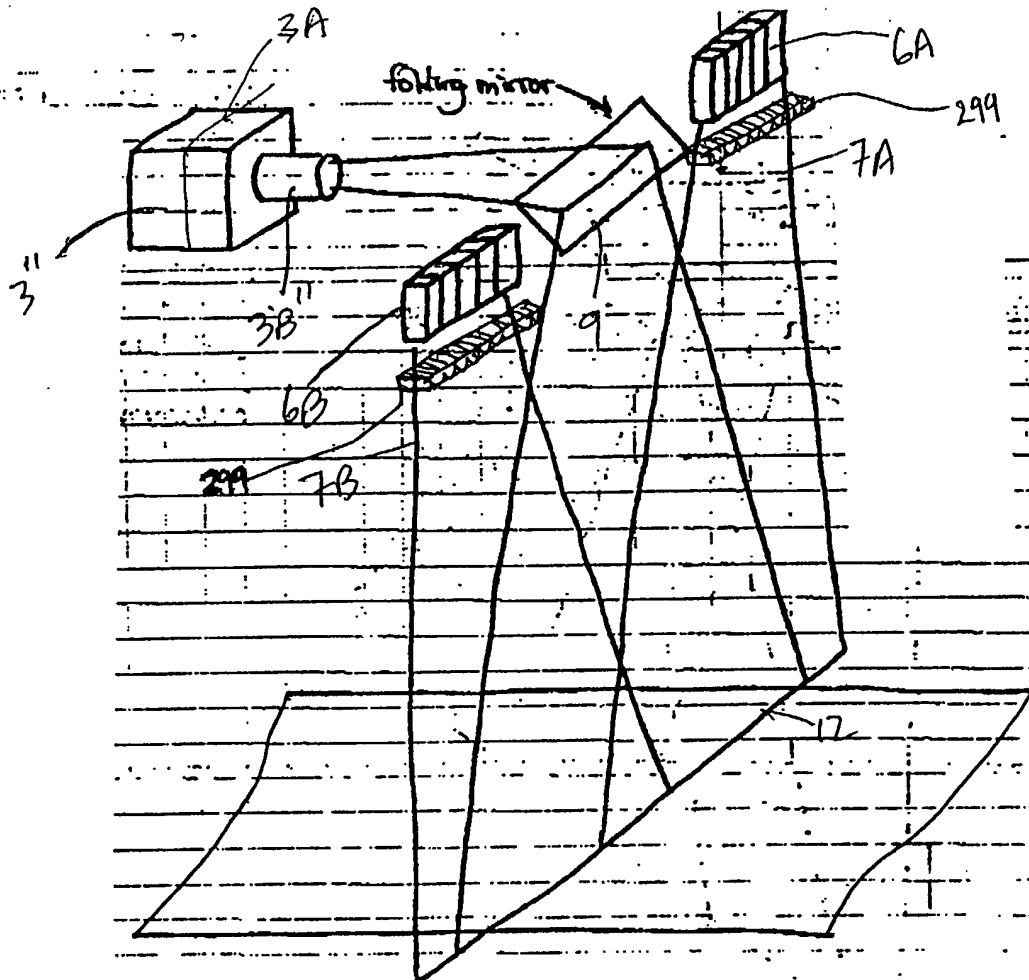


FIG. 3D7

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FIG. 3E1



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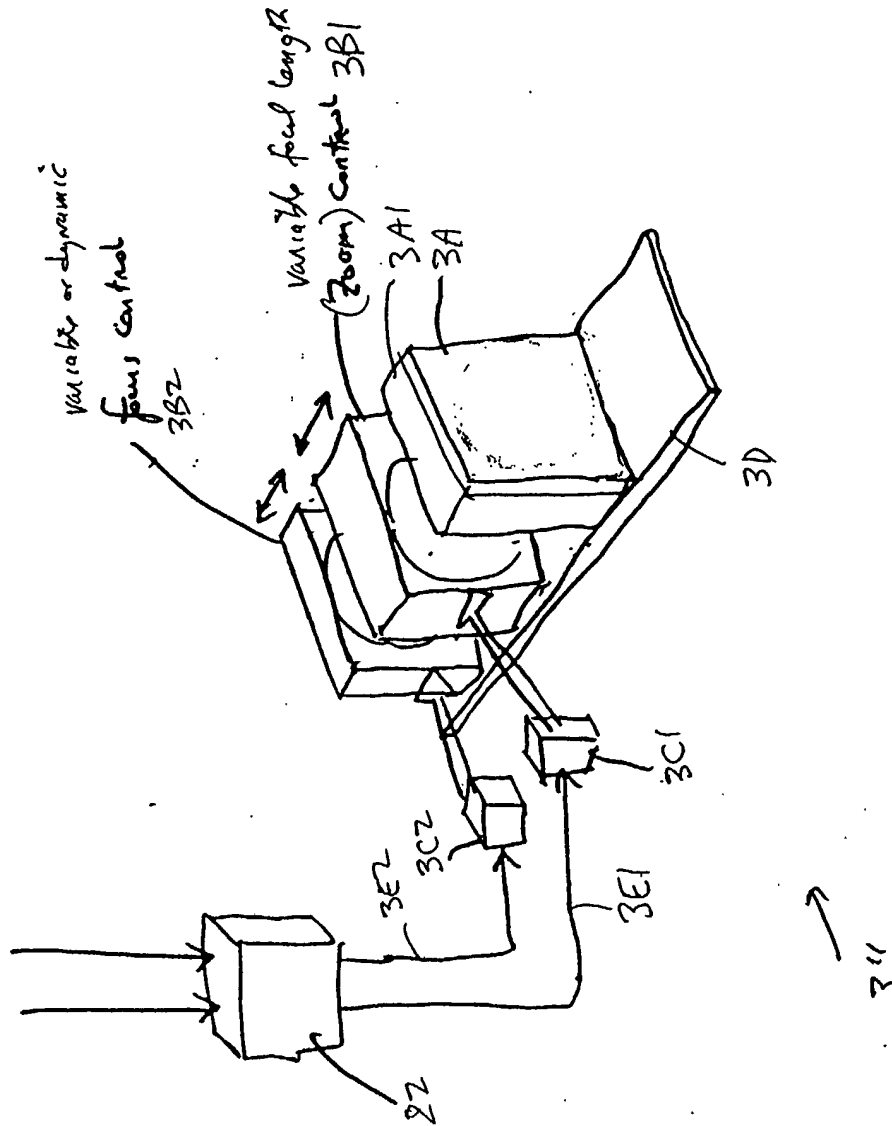
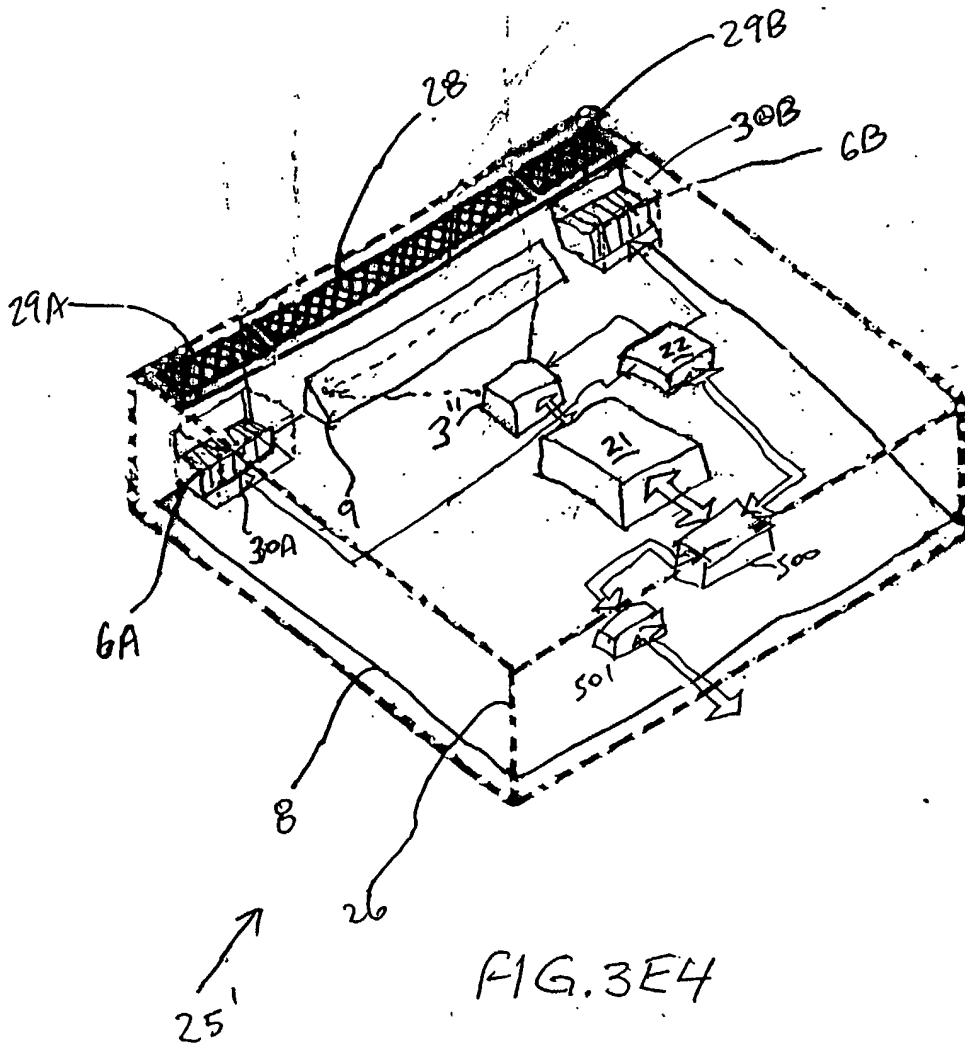


FIG. 3E3

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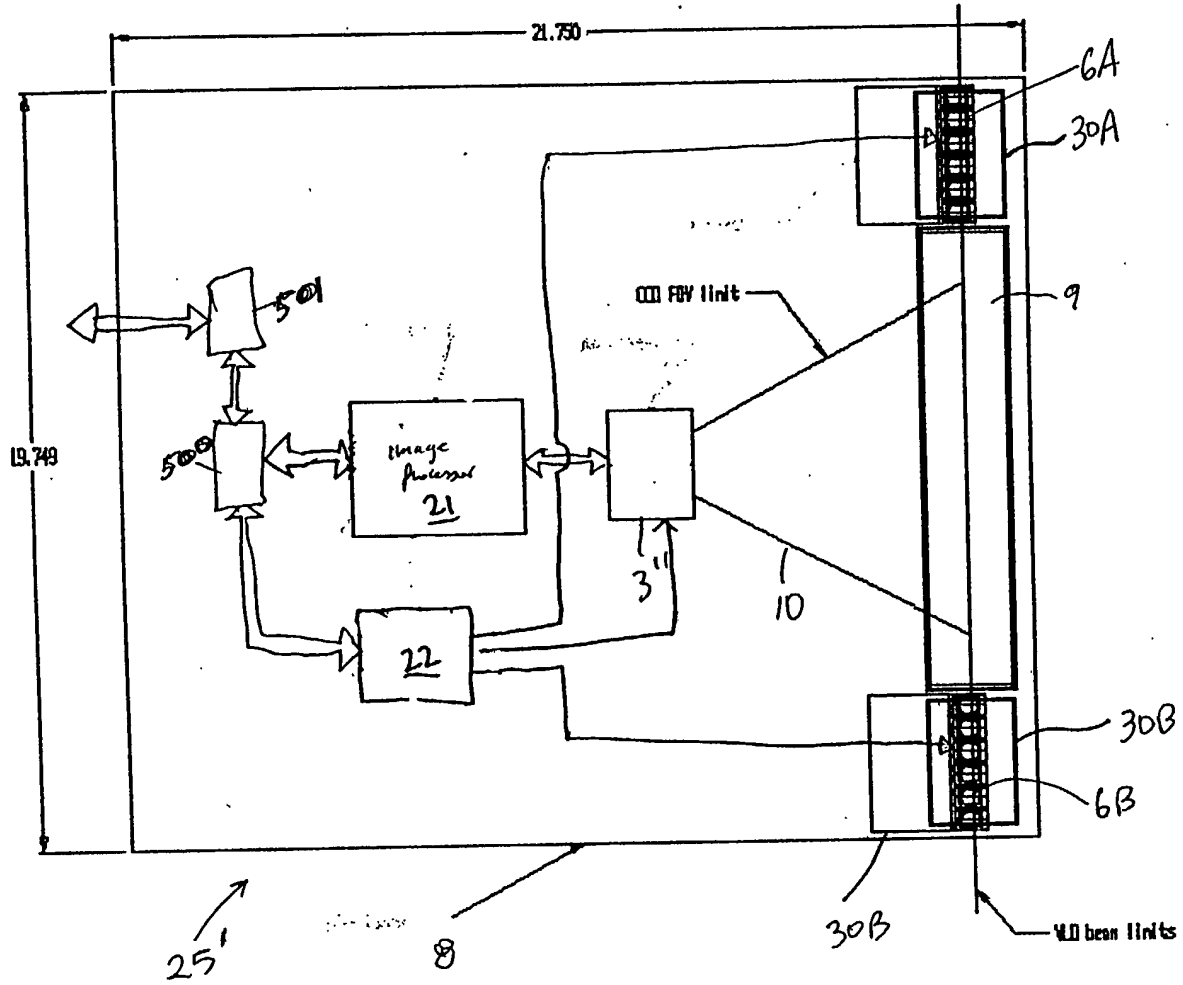


FIG. 3E5

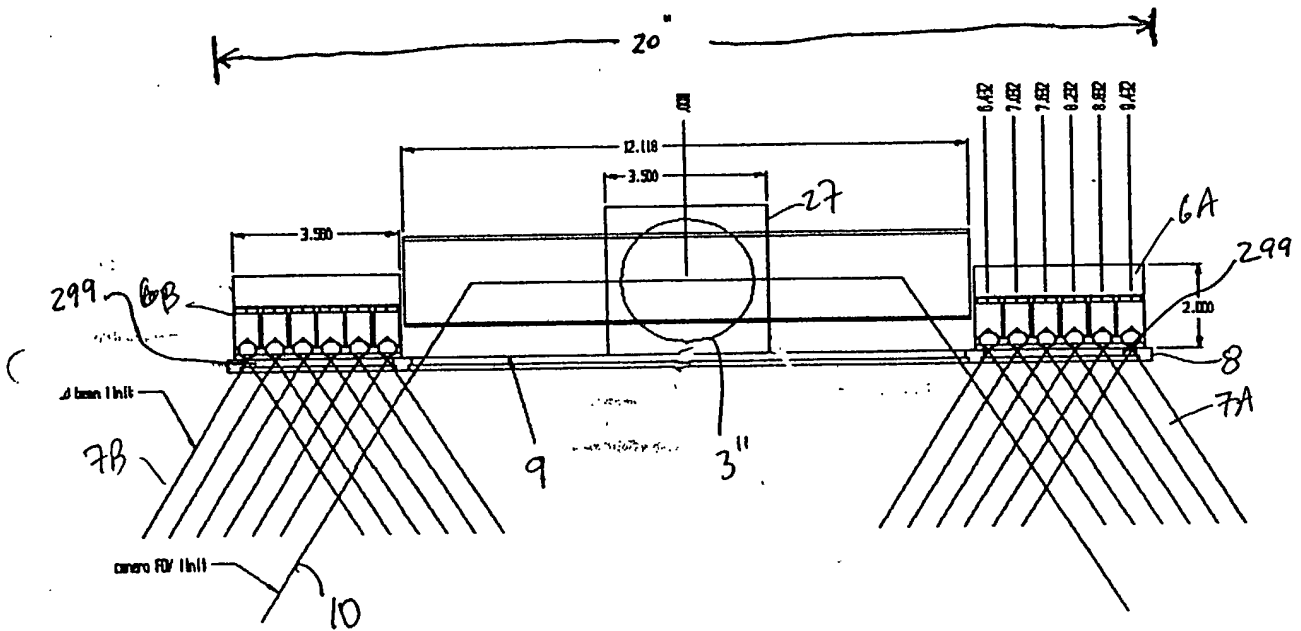
$$147 \overline{) 385}$$


FIG. 3E6

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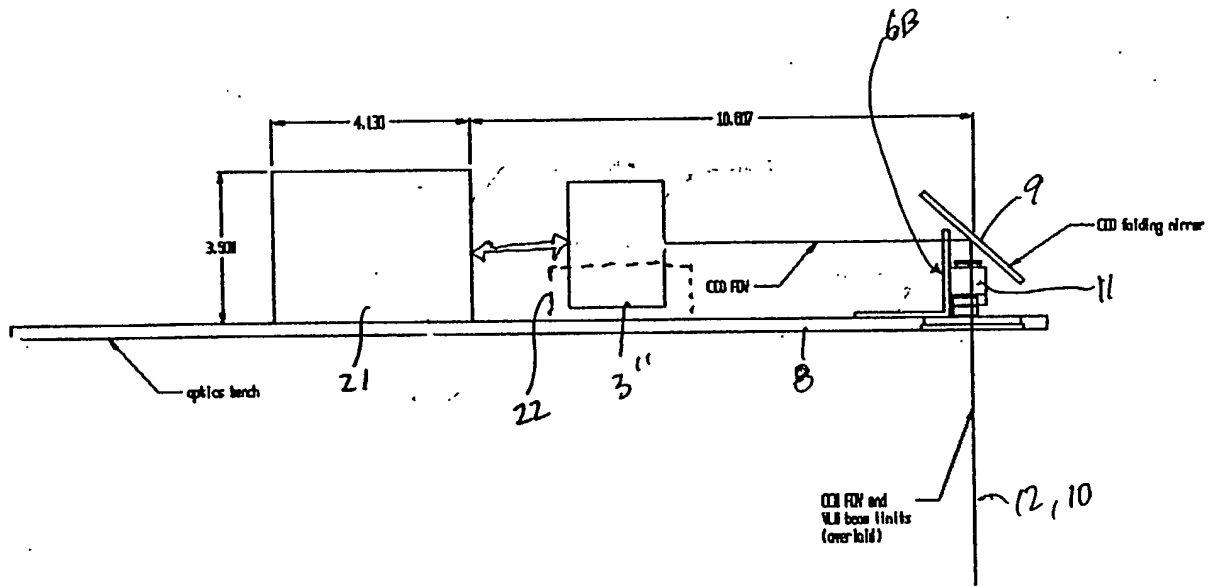


FIG. 3E7



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\*variable FOV

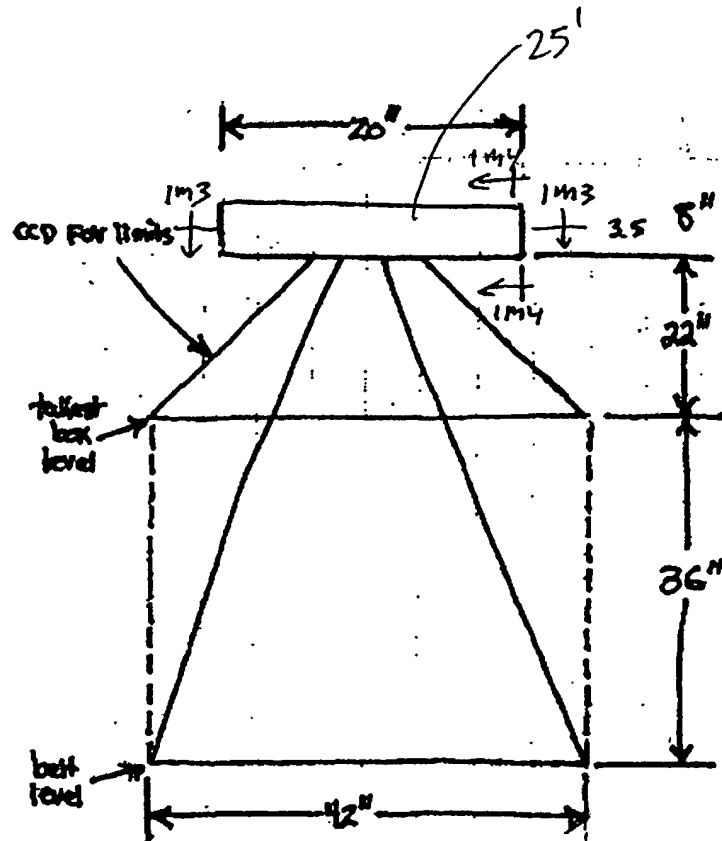


FIG. 3E8

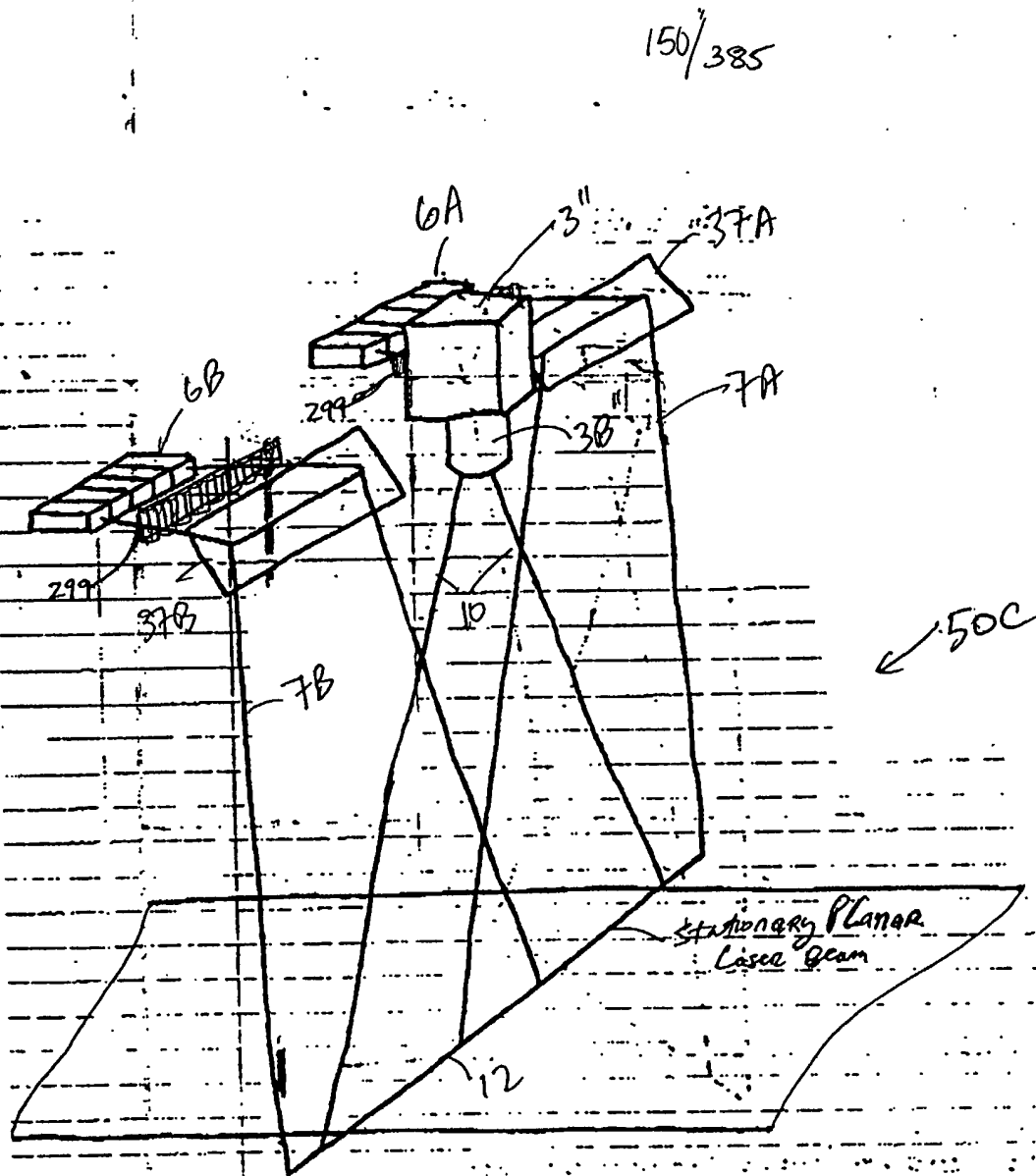
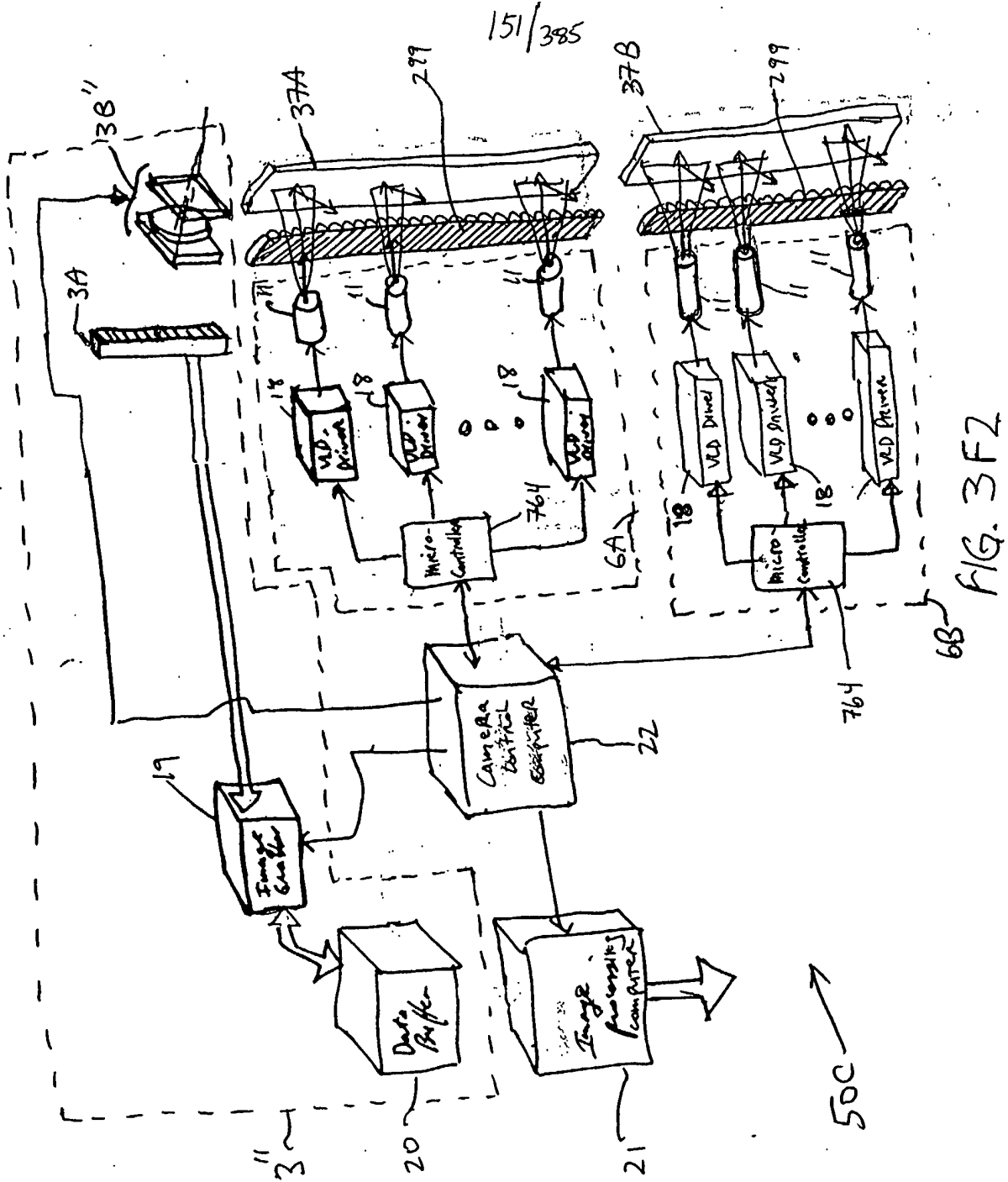


FIG. 3F1



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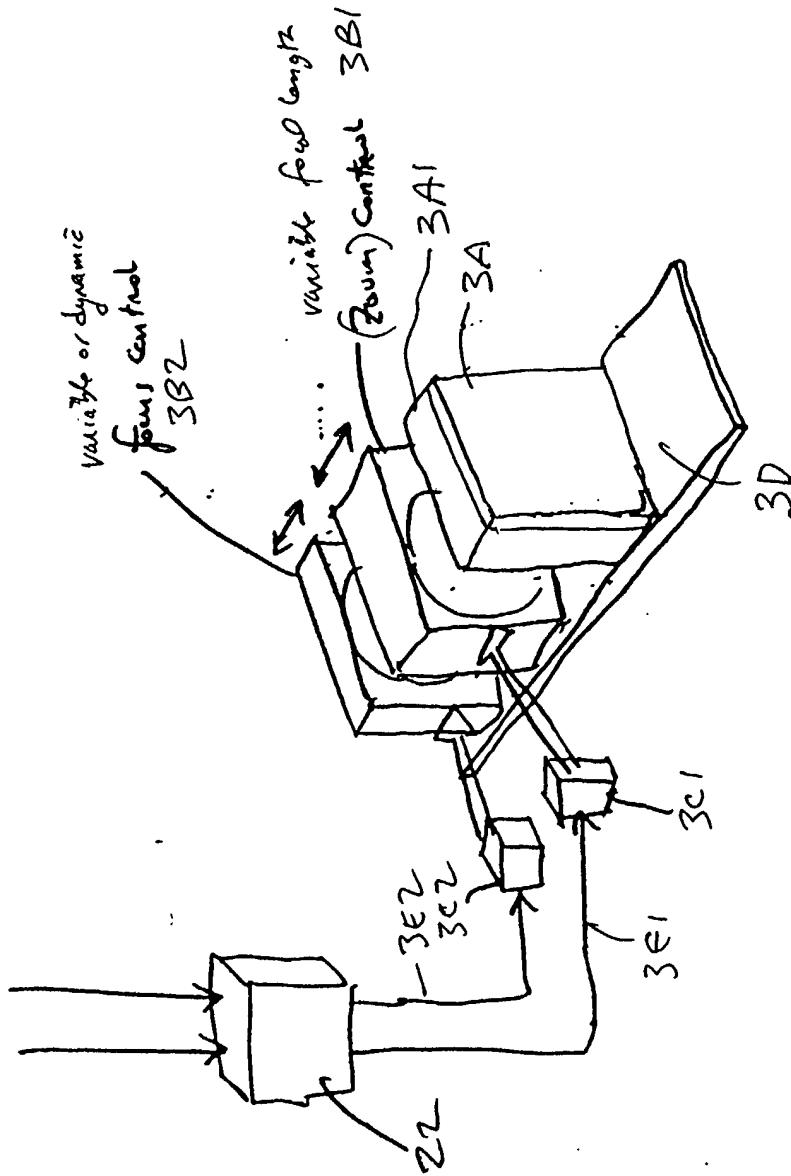


FIG. 3F3

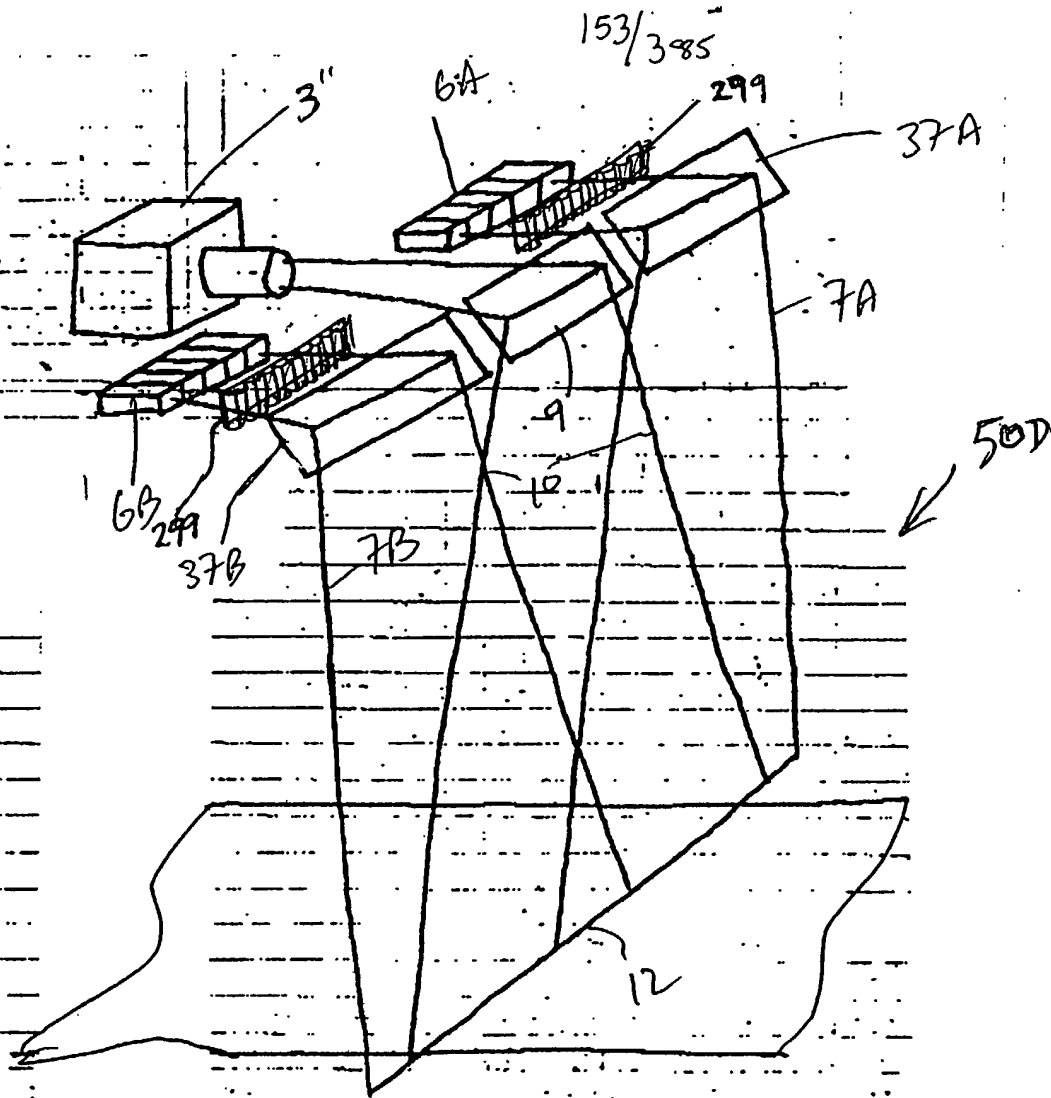


FIG. 351

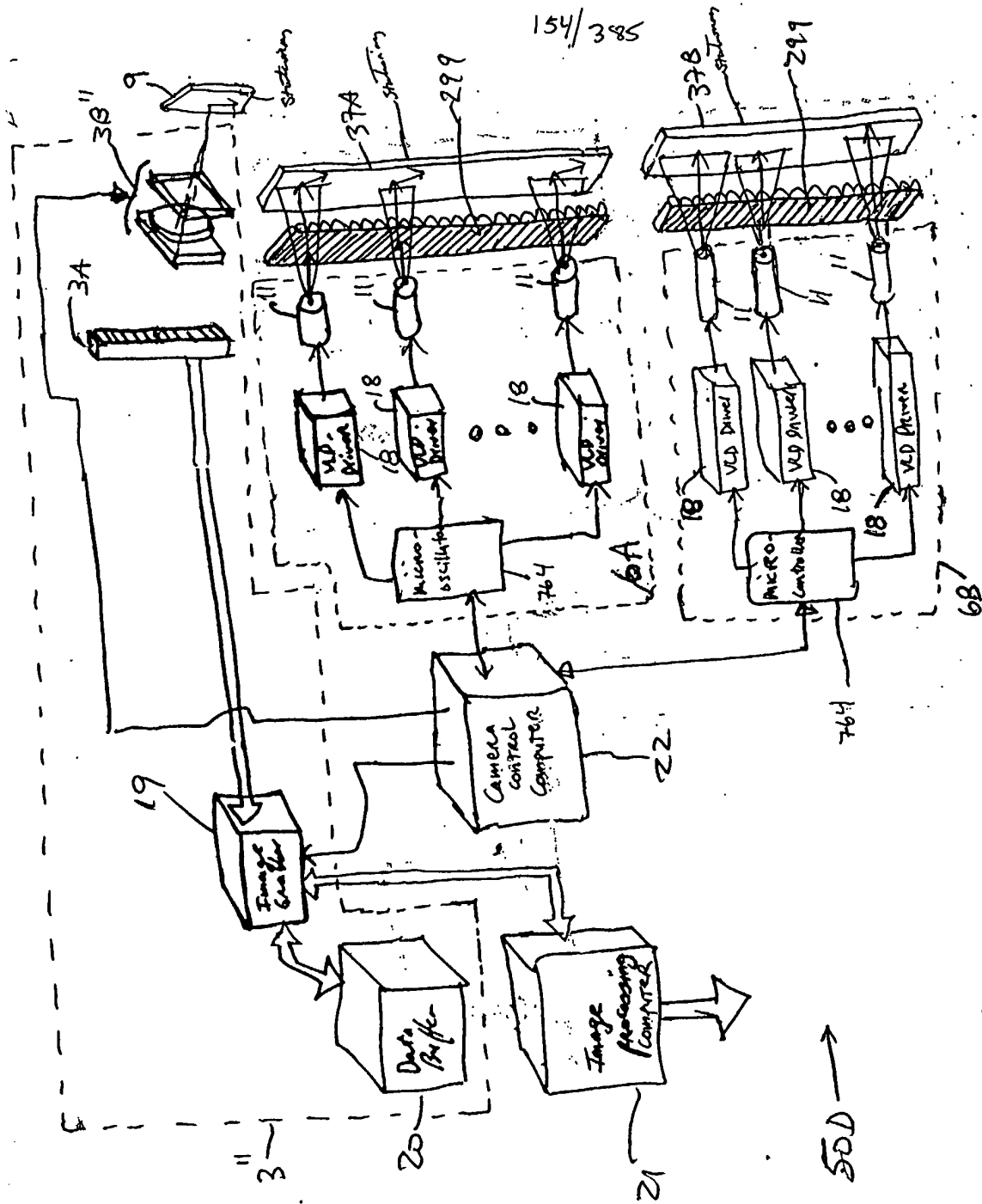


FIG. 362

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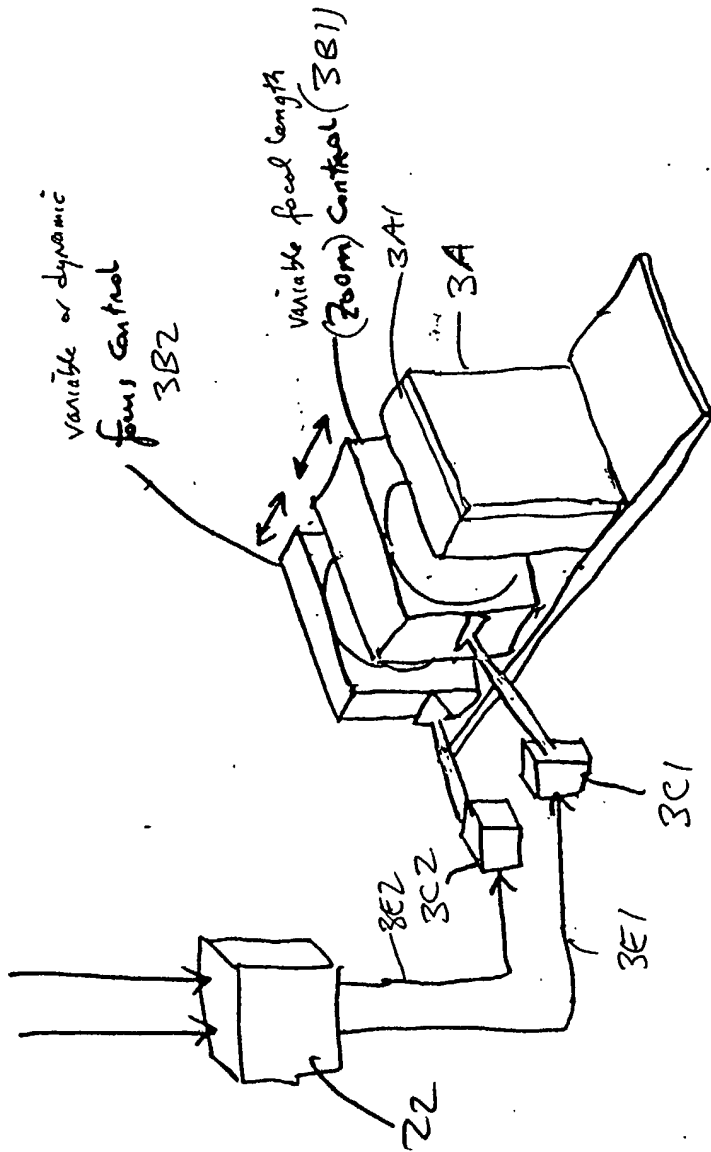


FIG. 393

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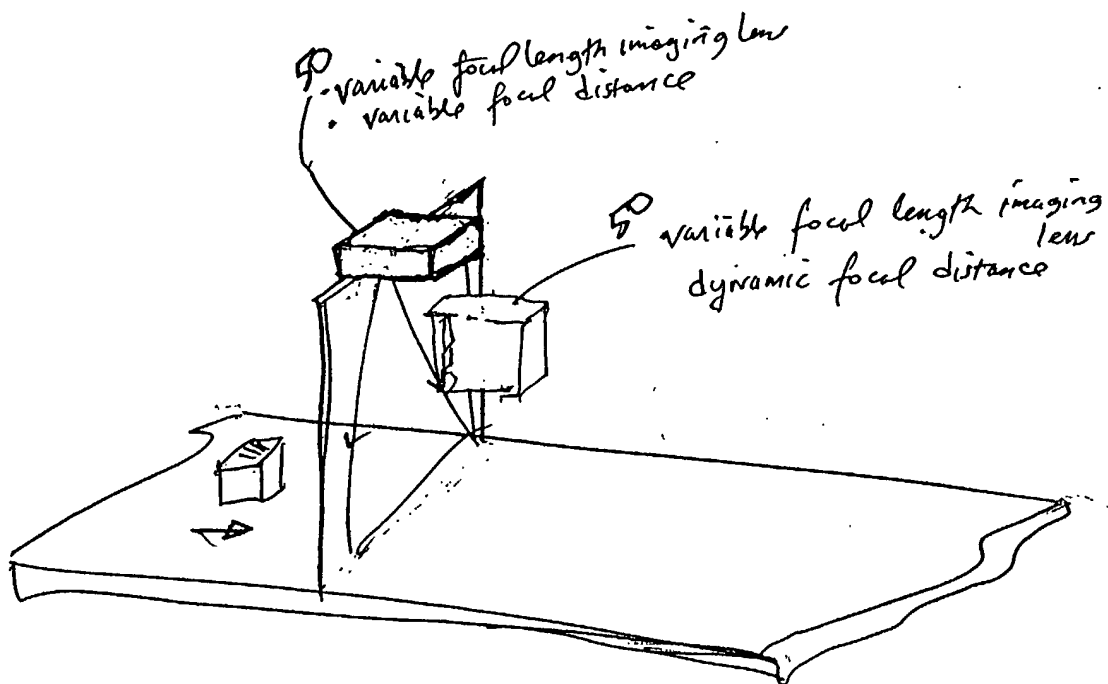


FIG. 3H



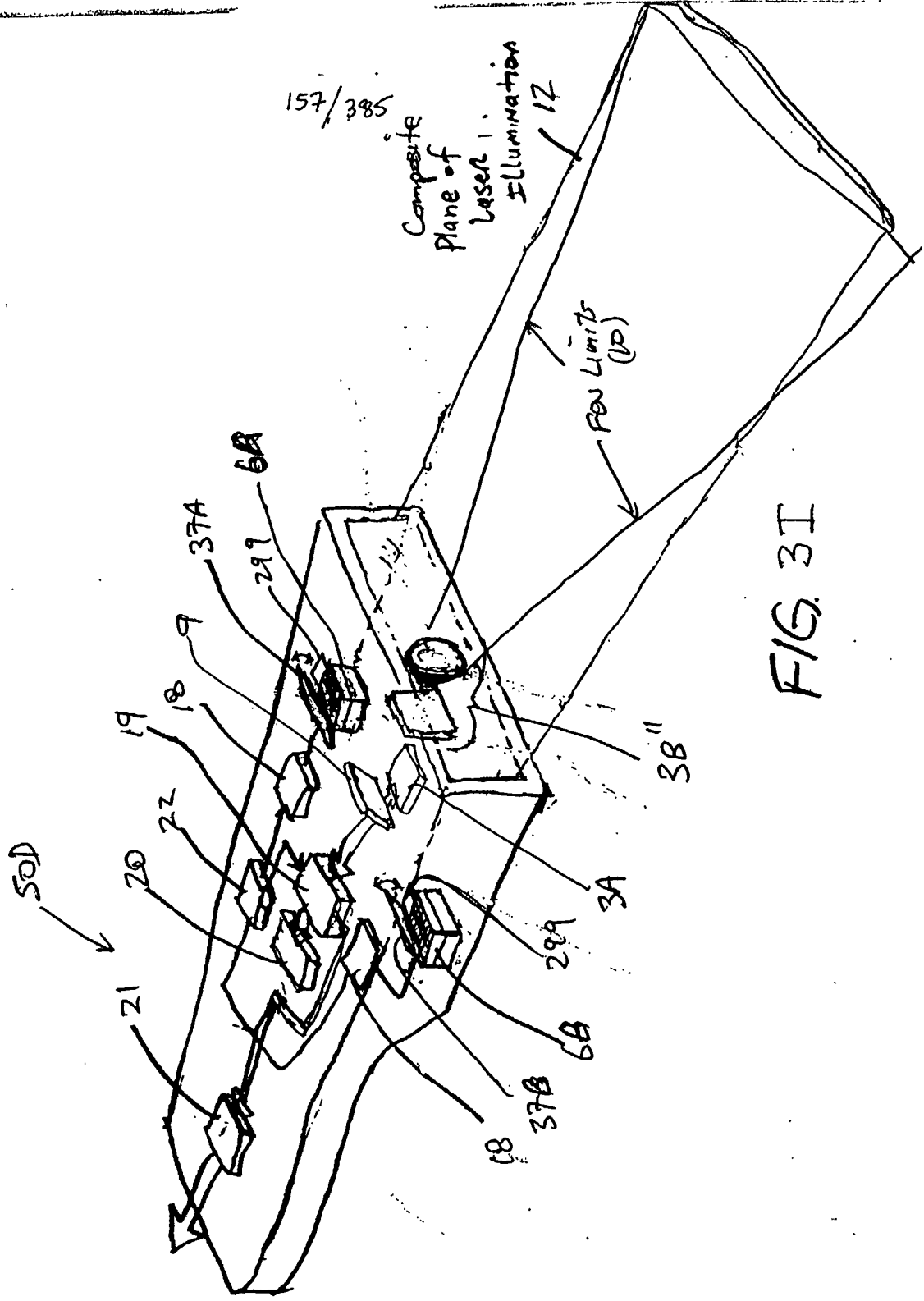


FIG. 3I

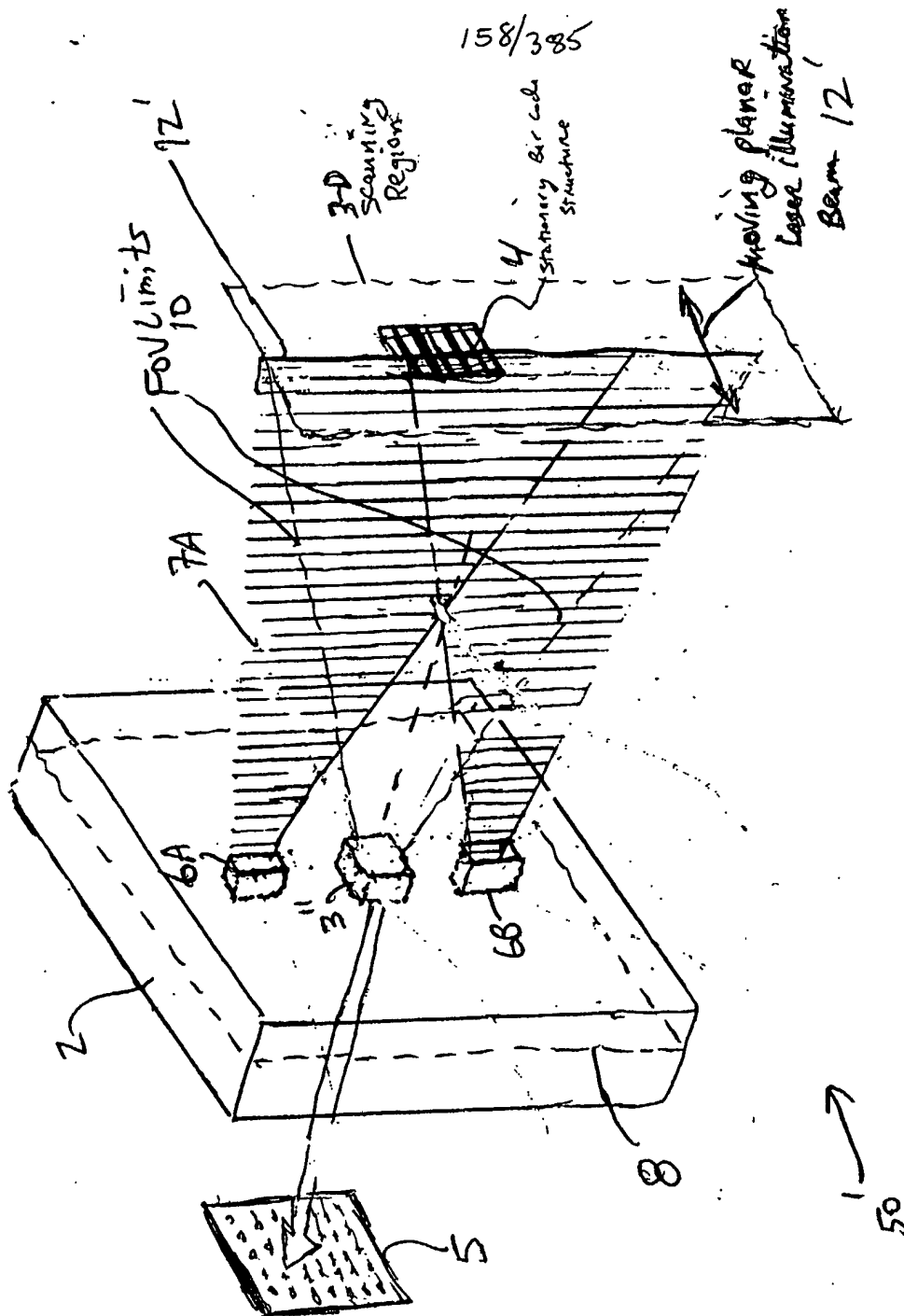


FIG. 3J

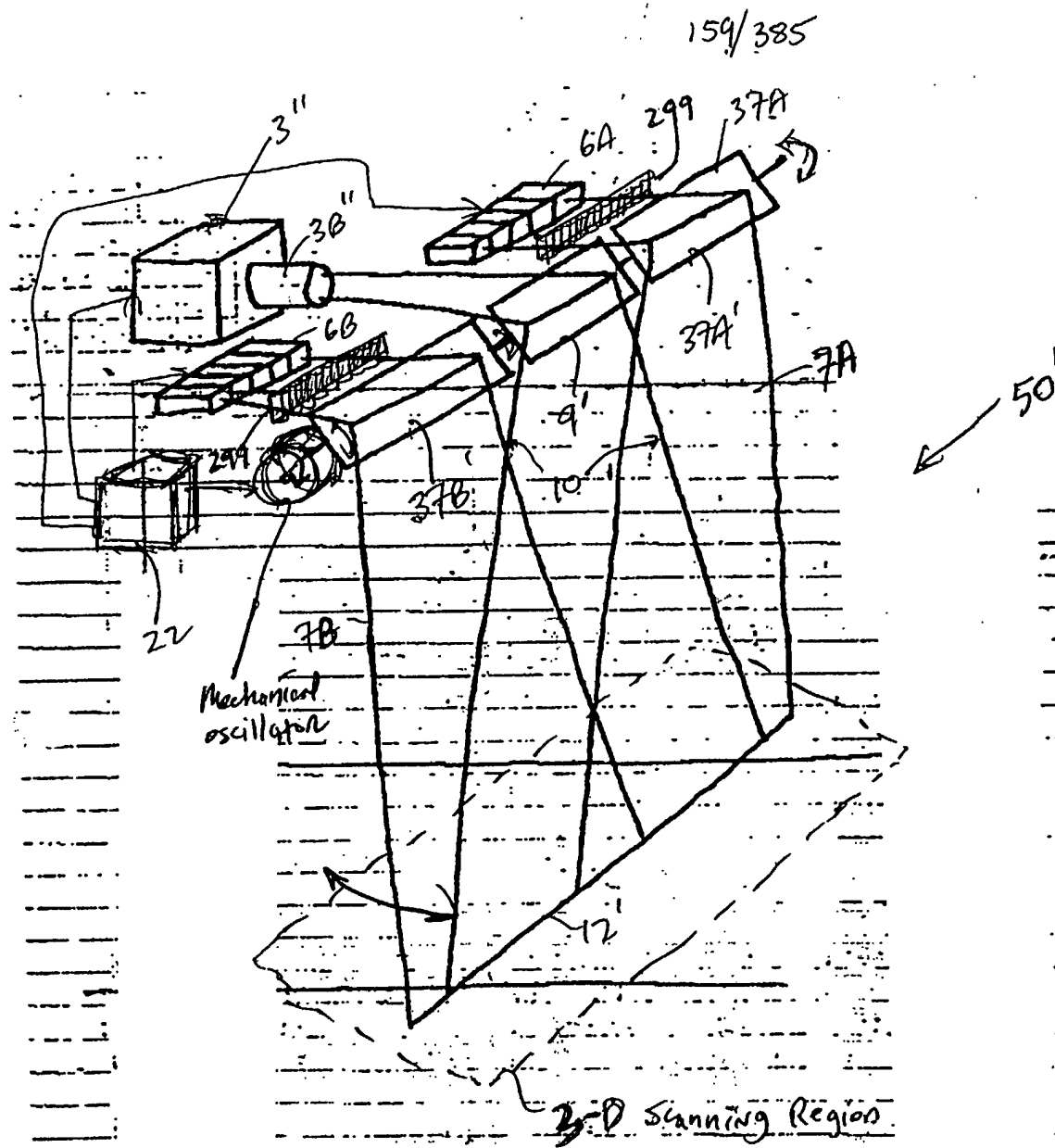


FIG 3J2

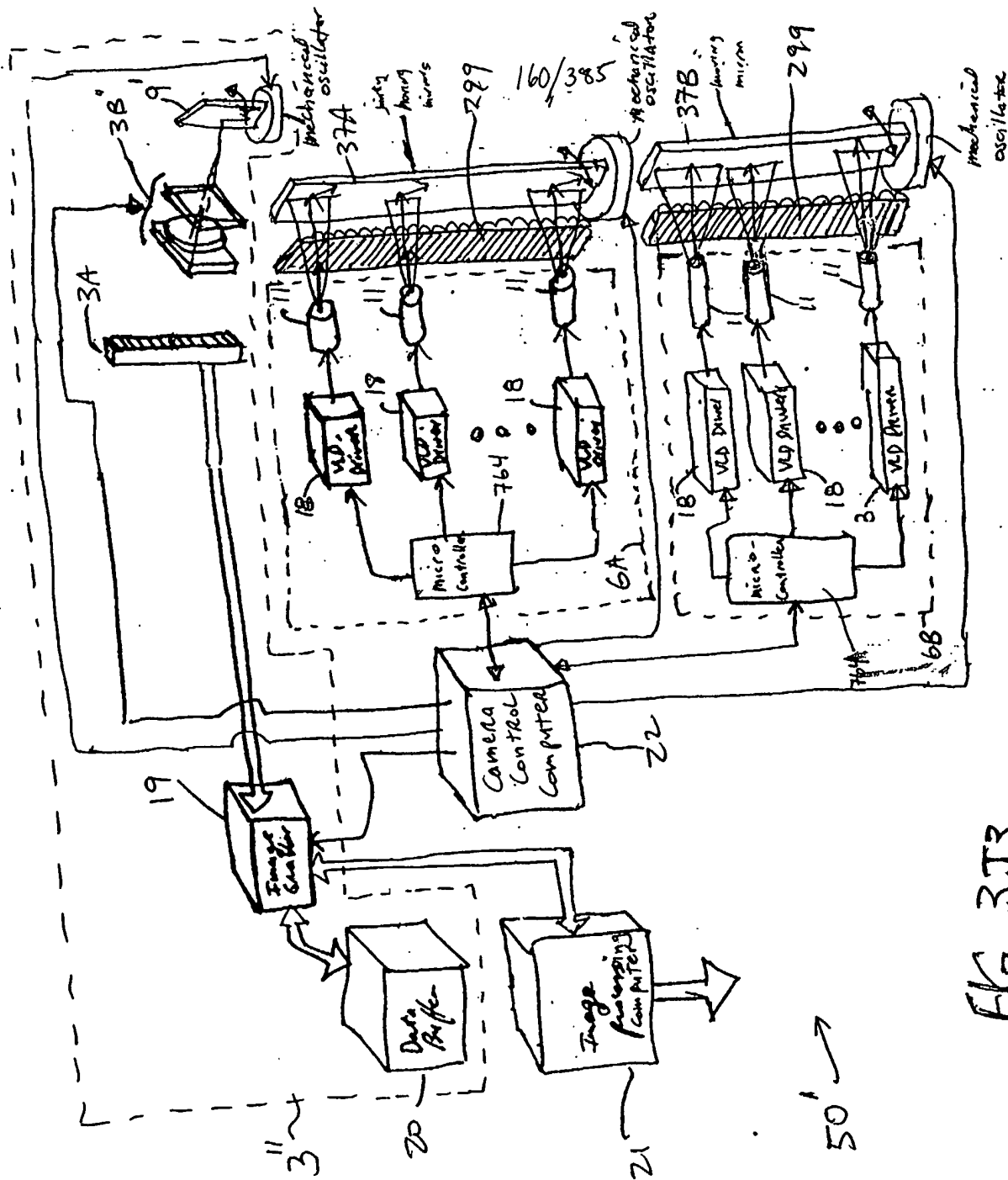


Fig. 3J3

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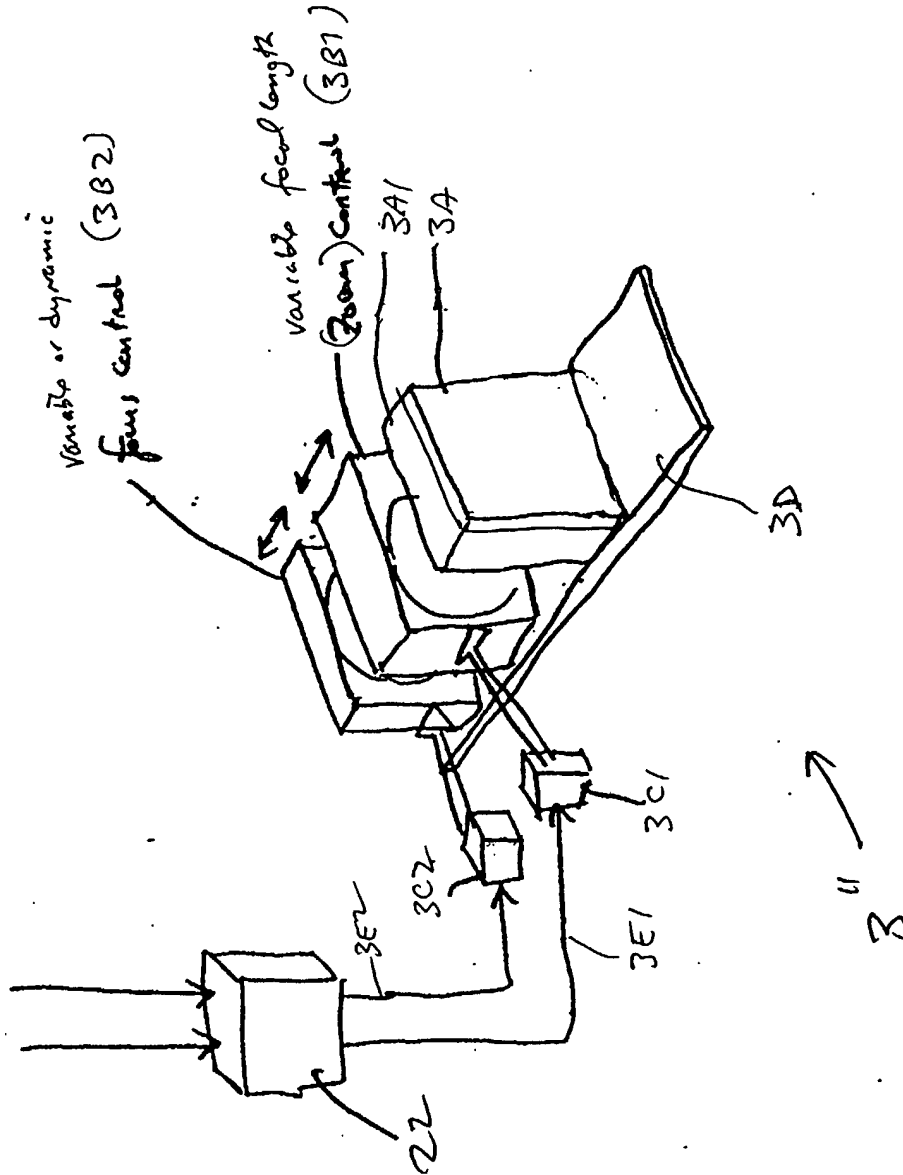


FIG. 3J4

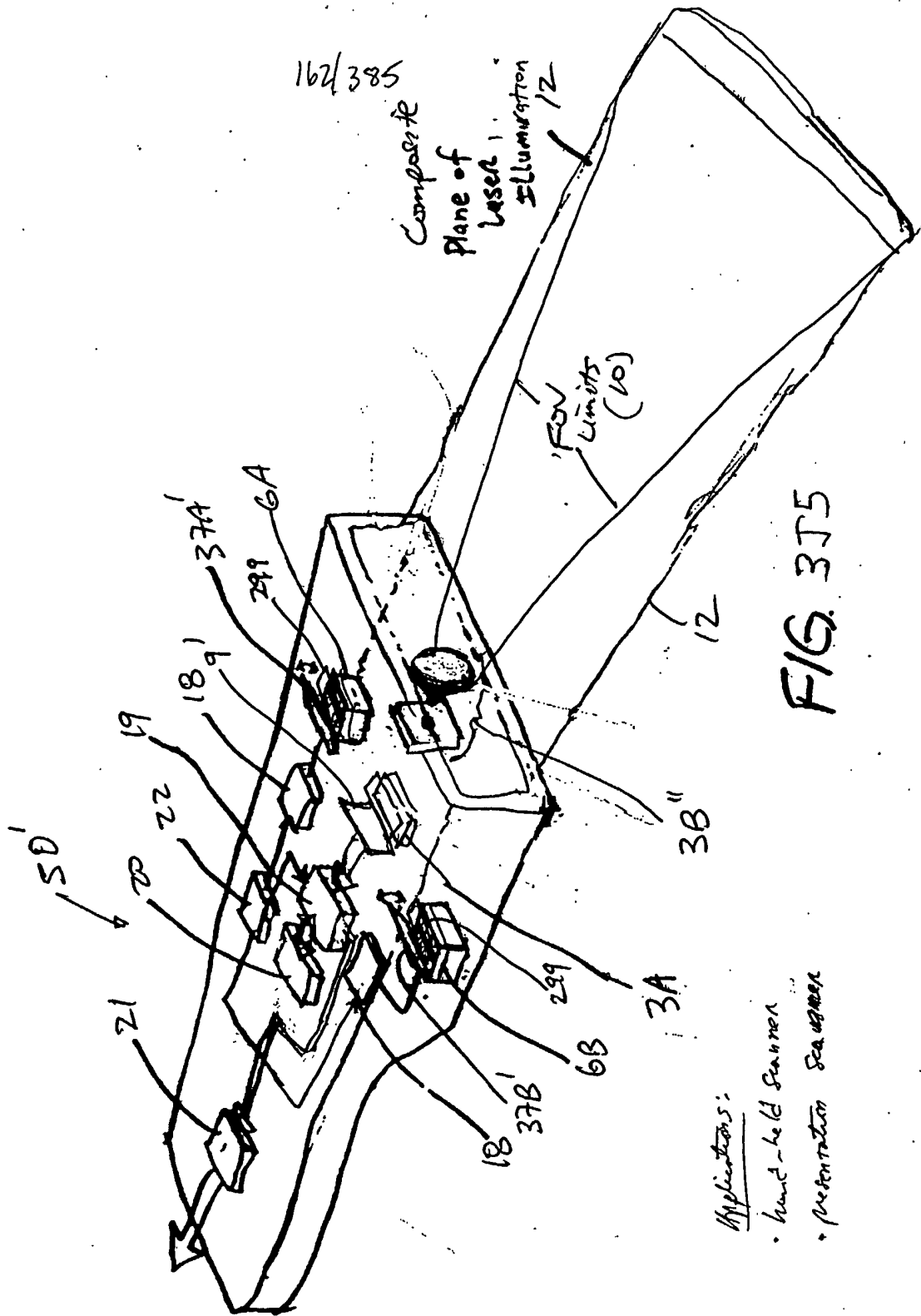


FIG. 3J5

Applications:

- hand-held scanner
- presentation scanner

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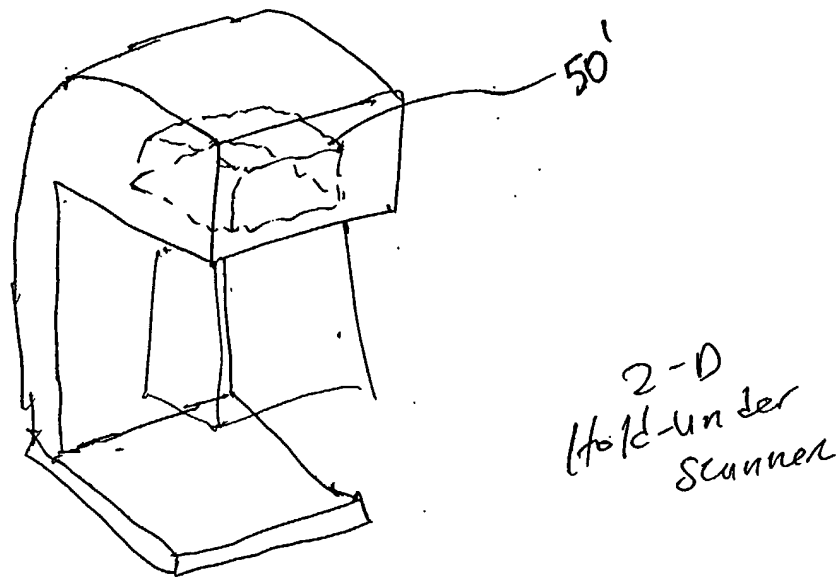


FIG. 316

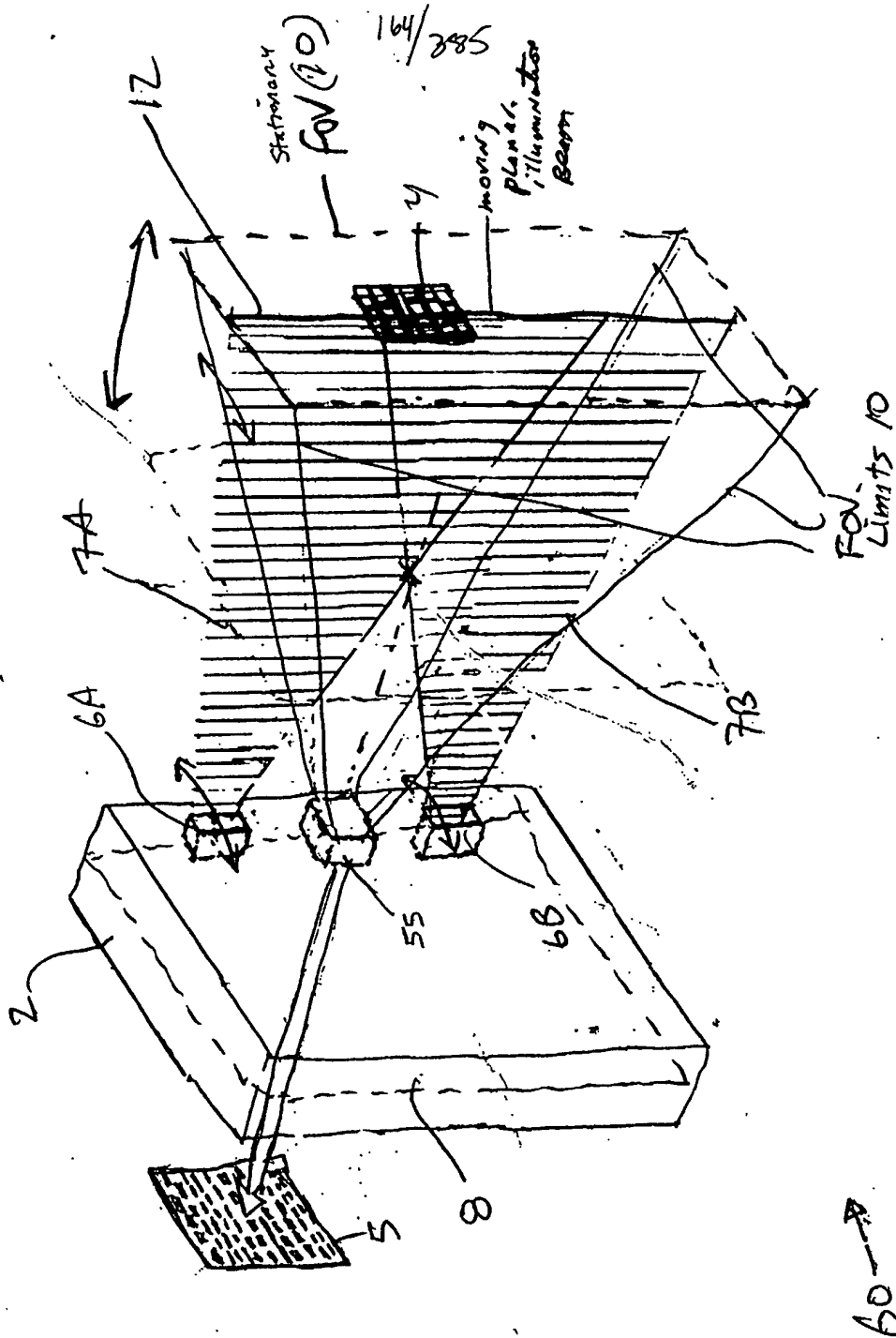


FIG 4A



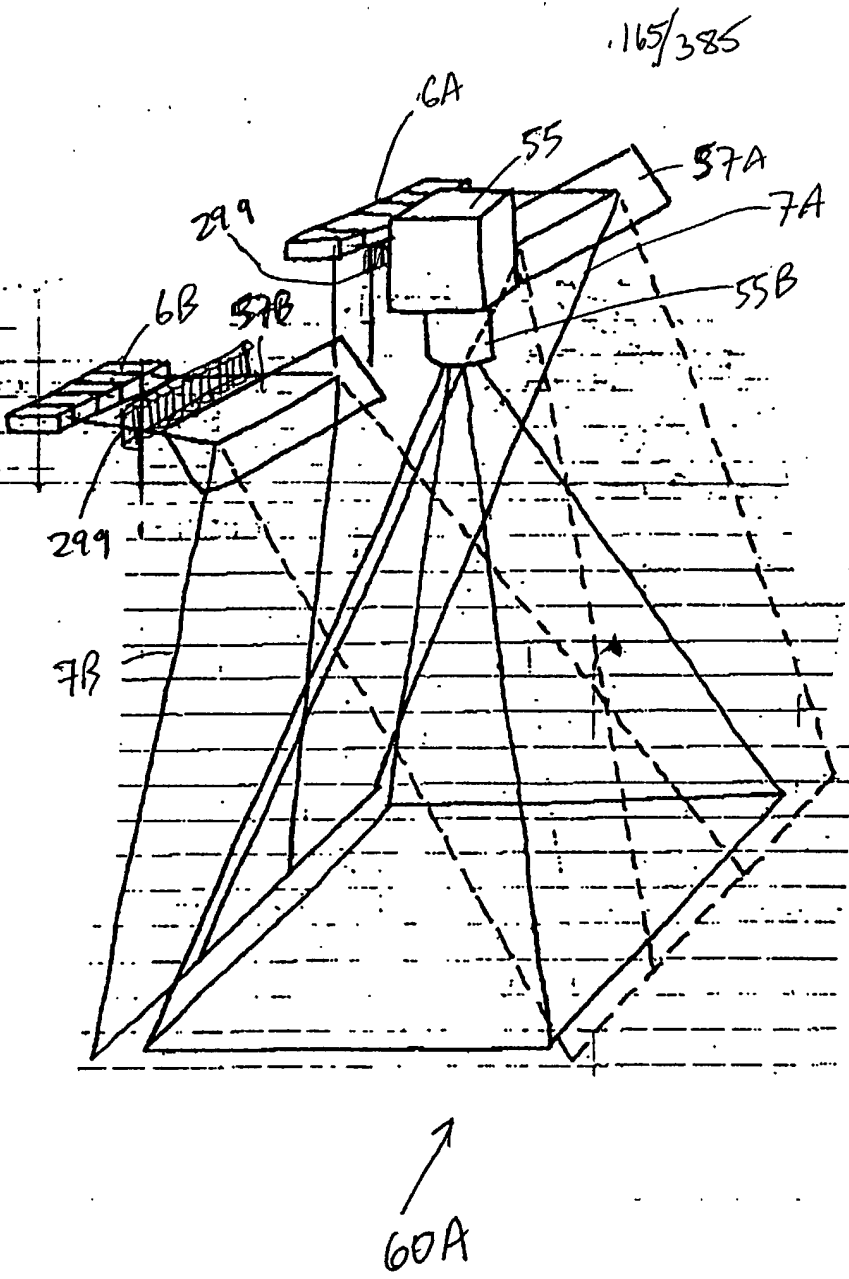


FIG. 4B1

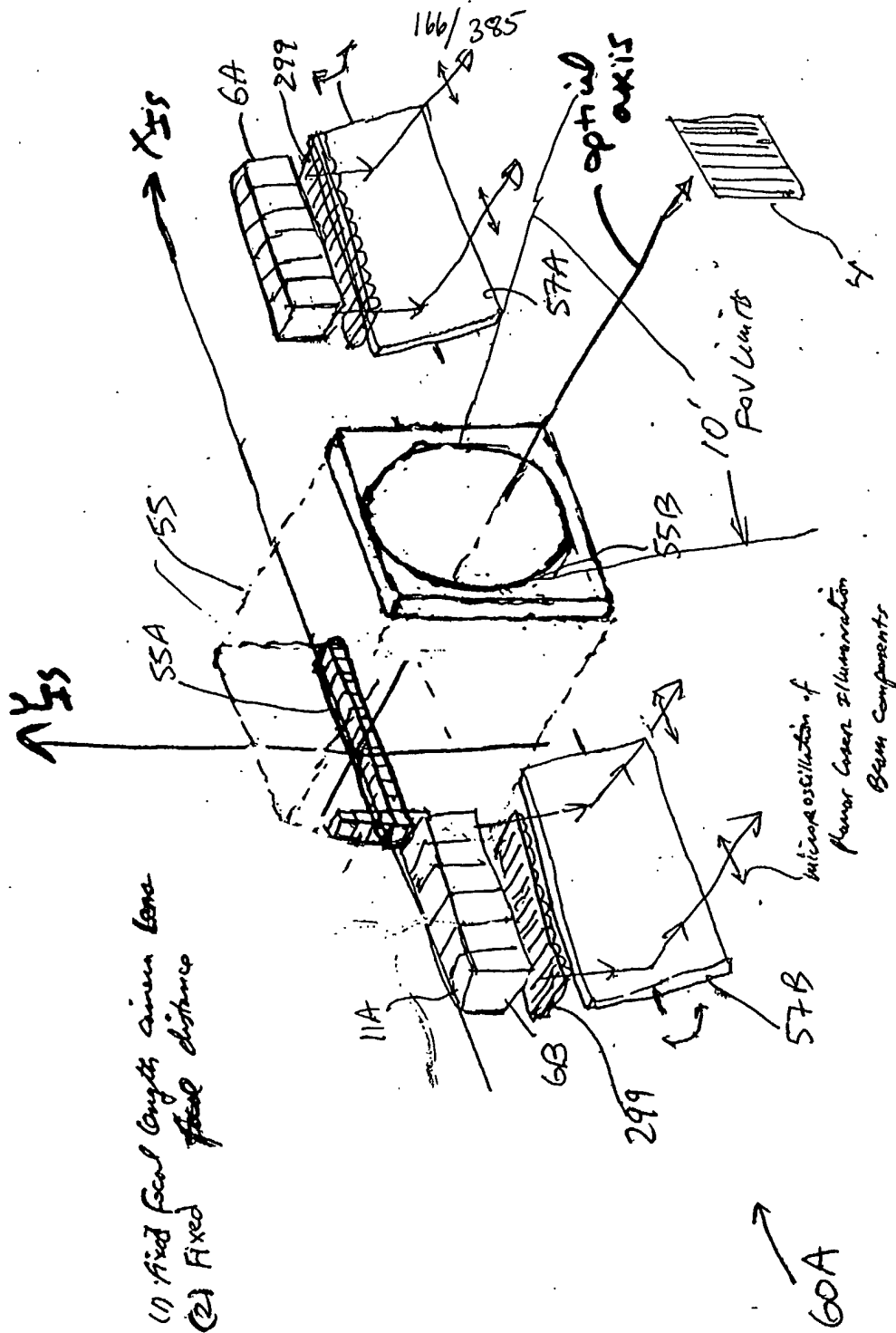
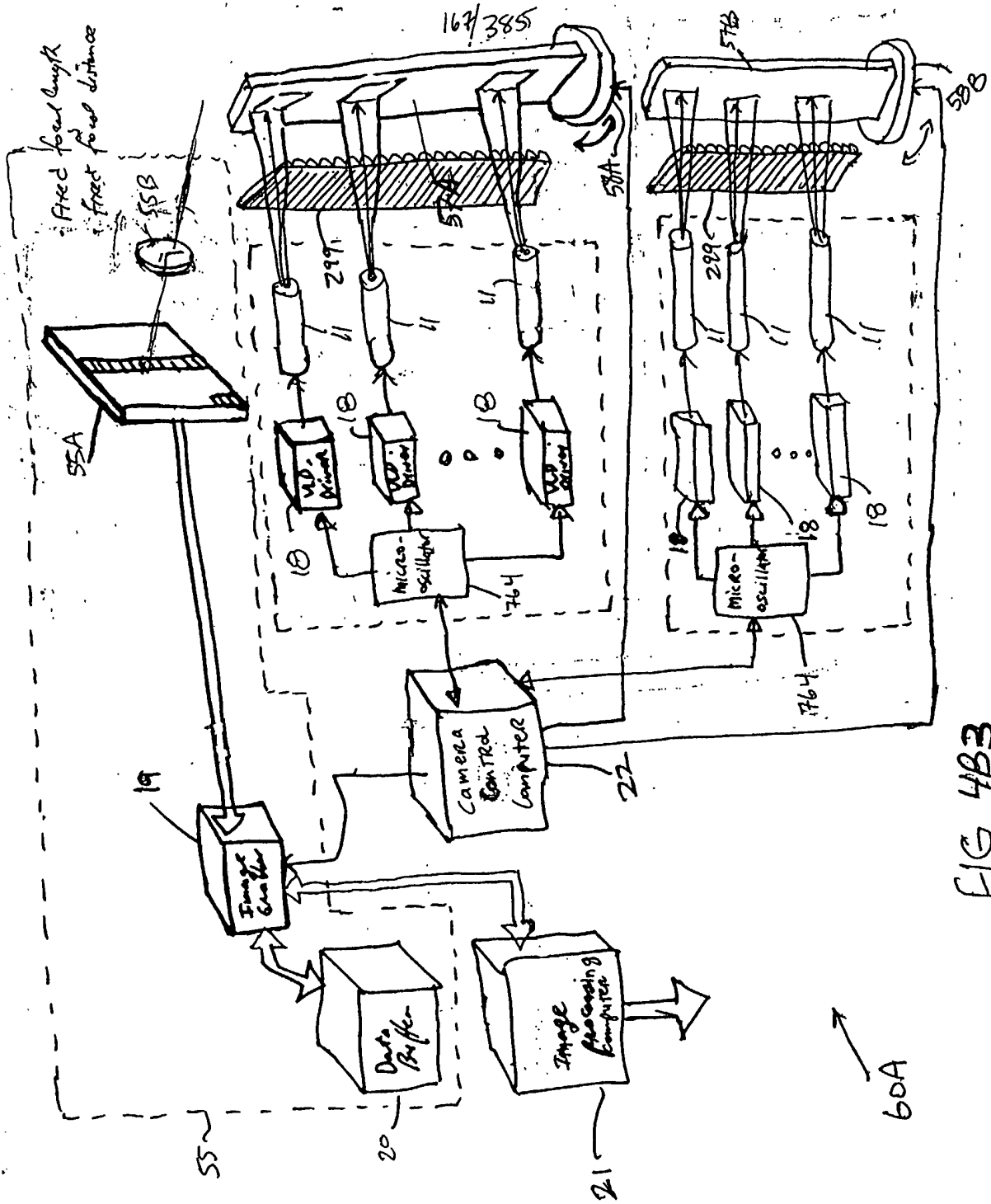


FIG. 4B.Z



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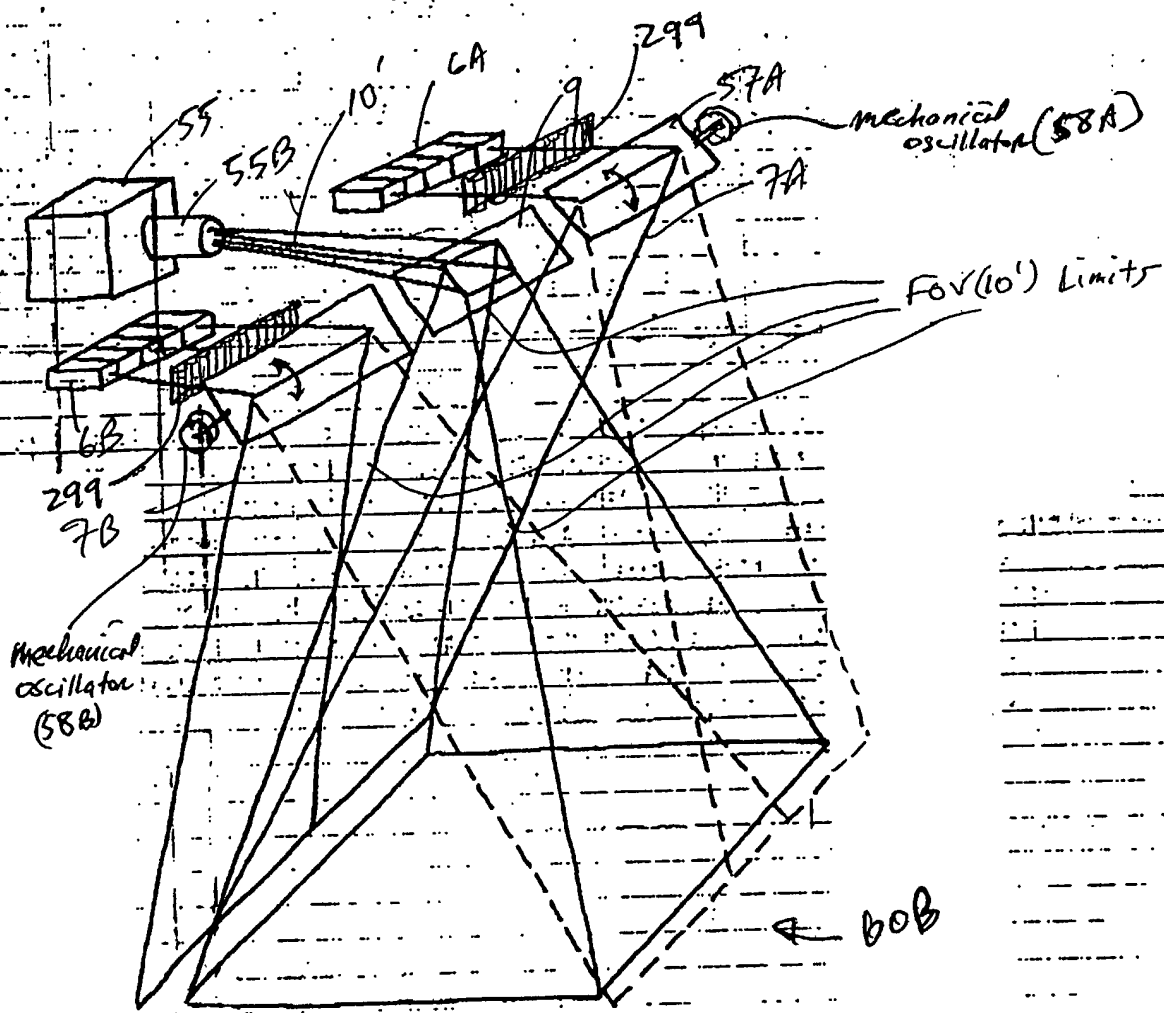


FIG. 4C

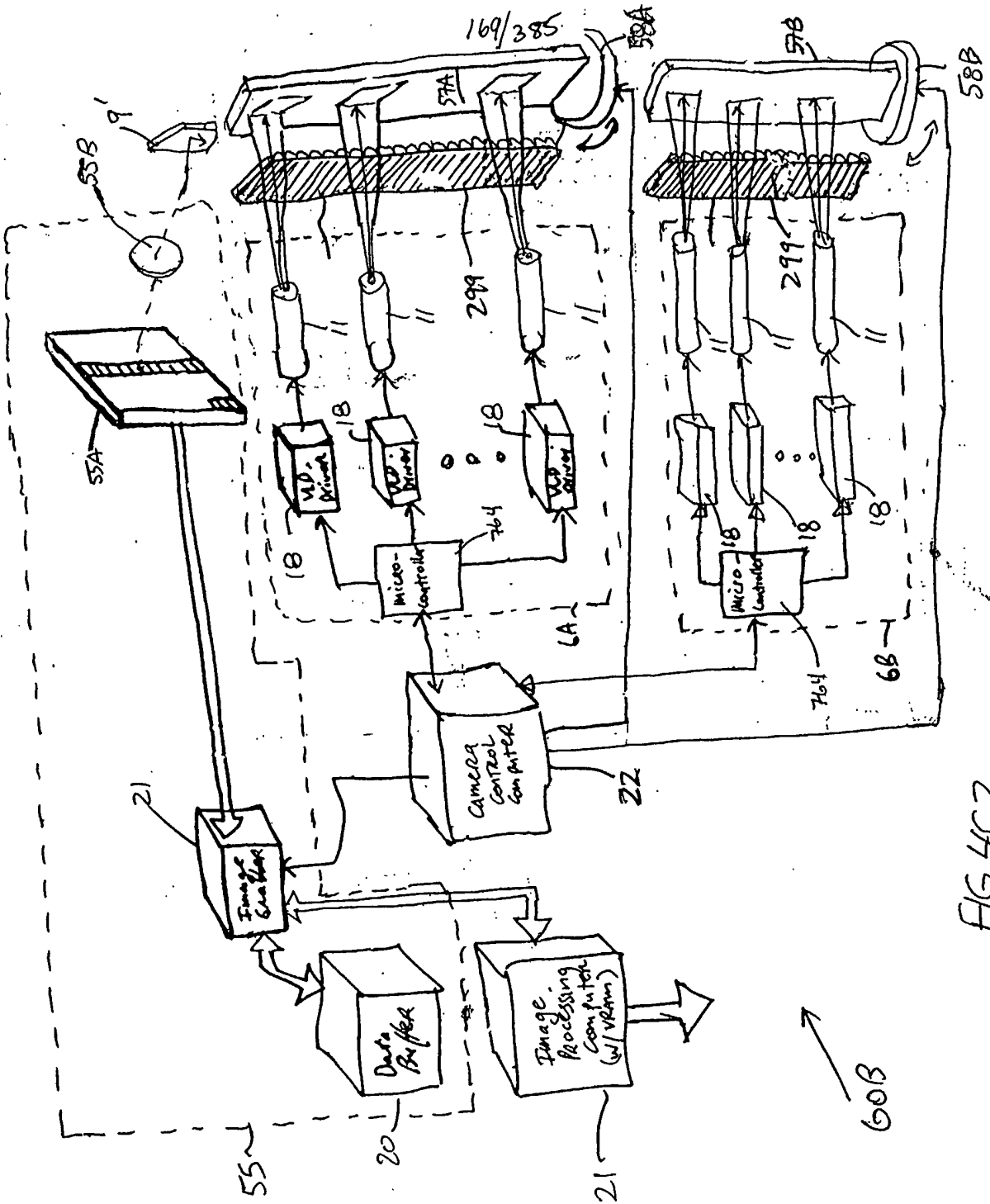


FIG. 4C2

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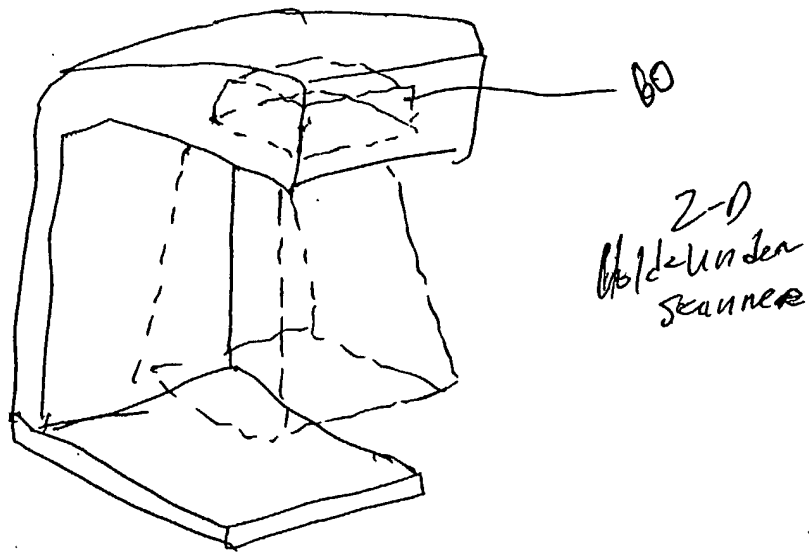


FIG. 4D

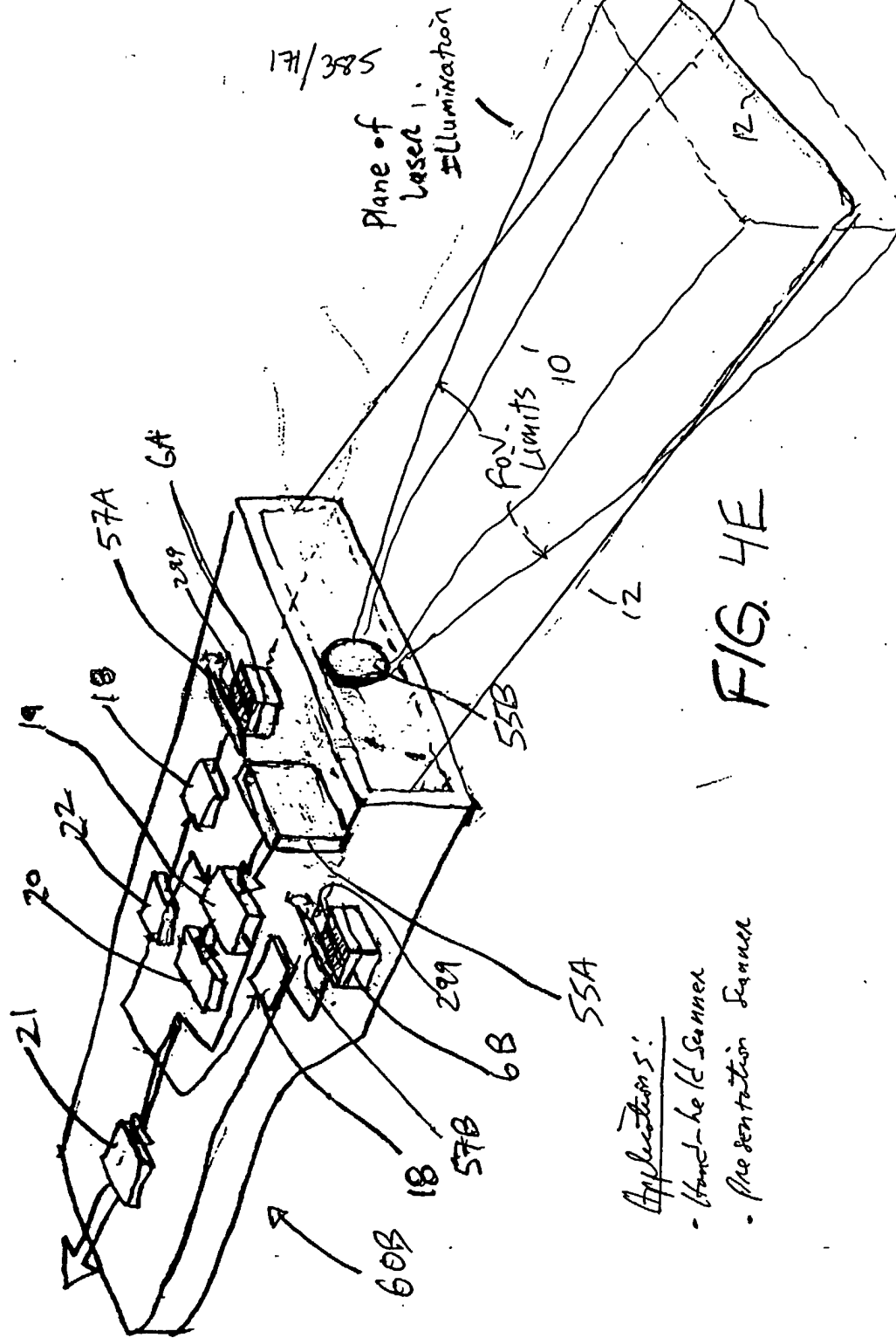


FIG. 4E

Applications:

- Hand-held Scanner
- Presentation Scanner

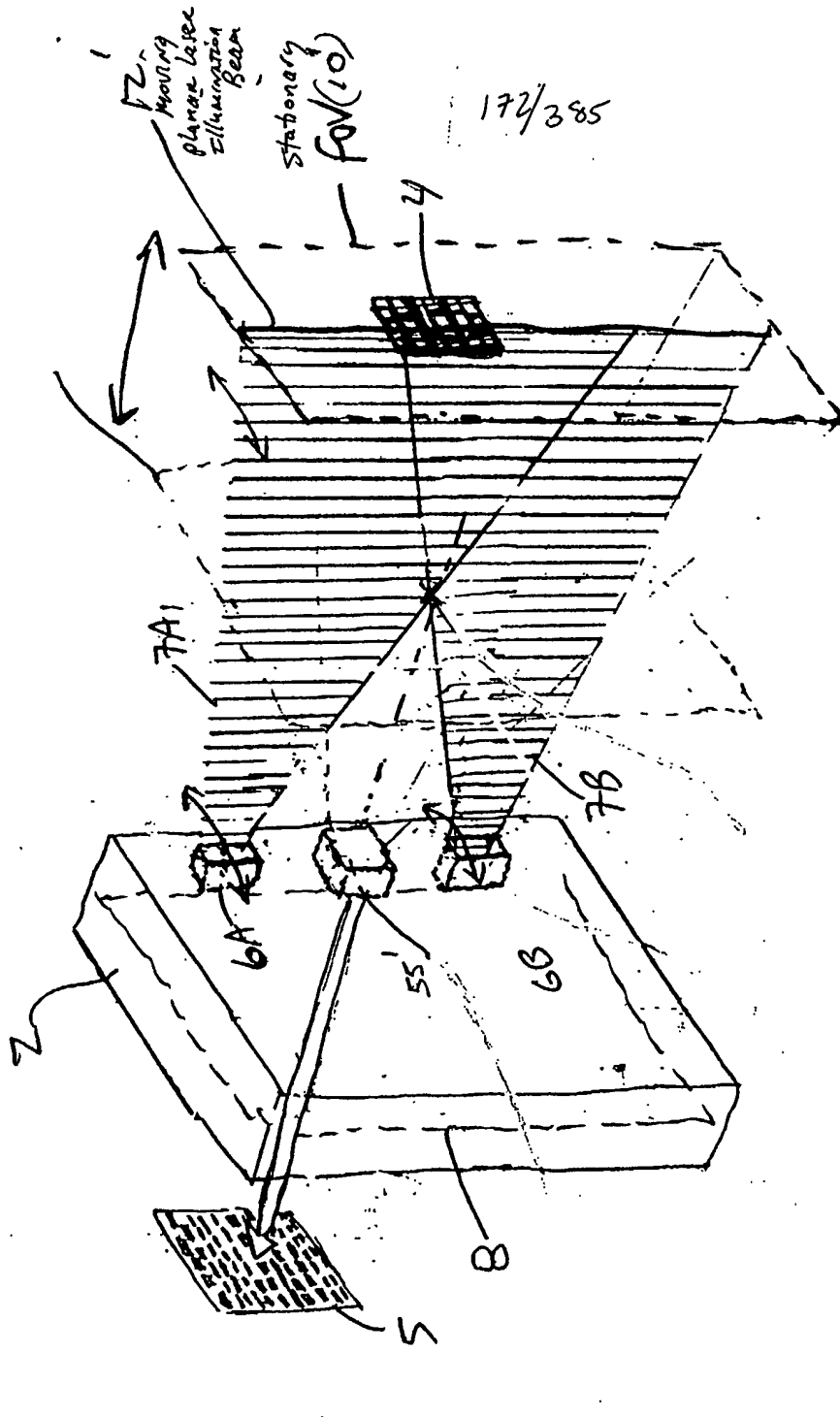


FIG. 5A



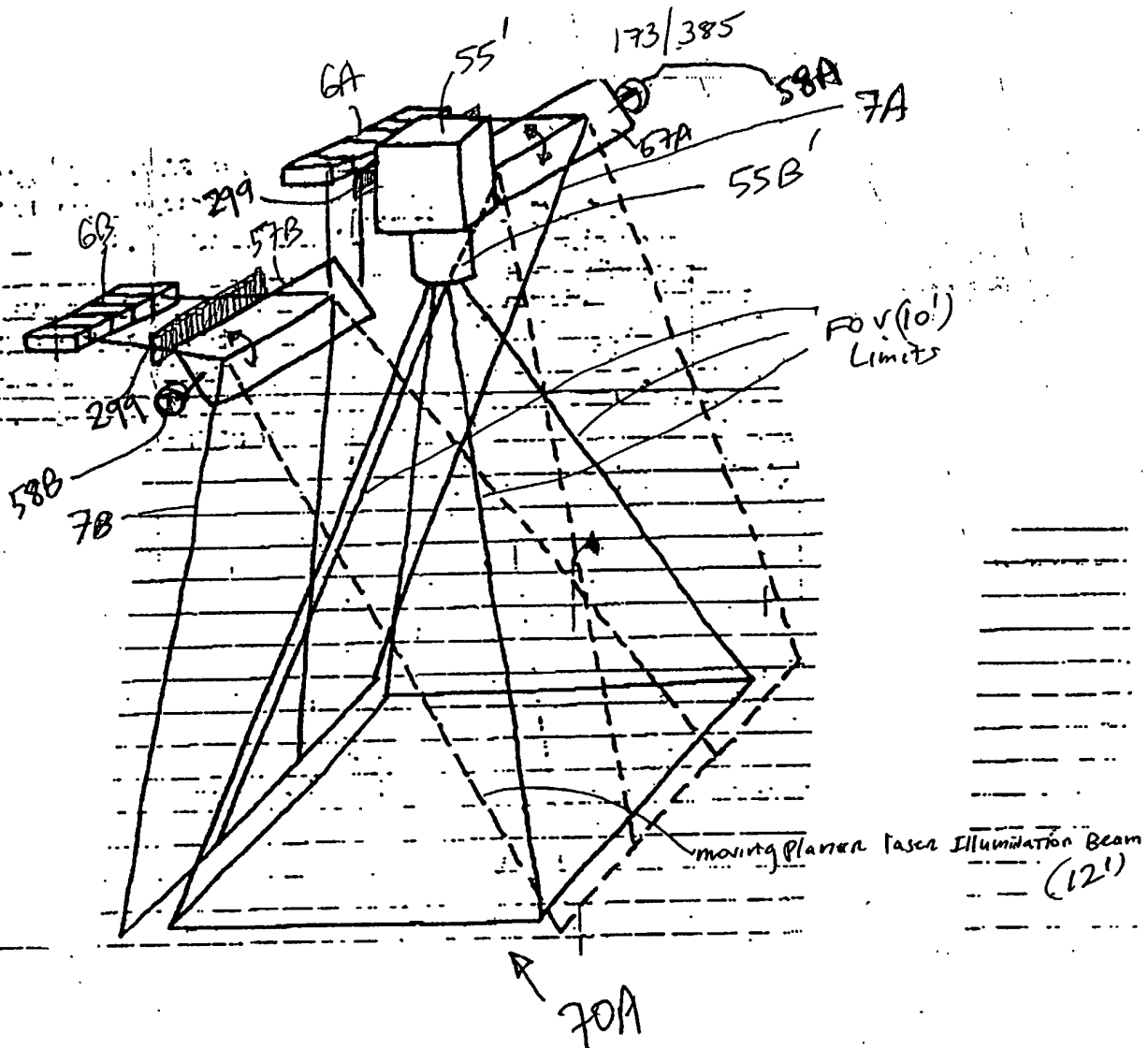


FIG. 5B1

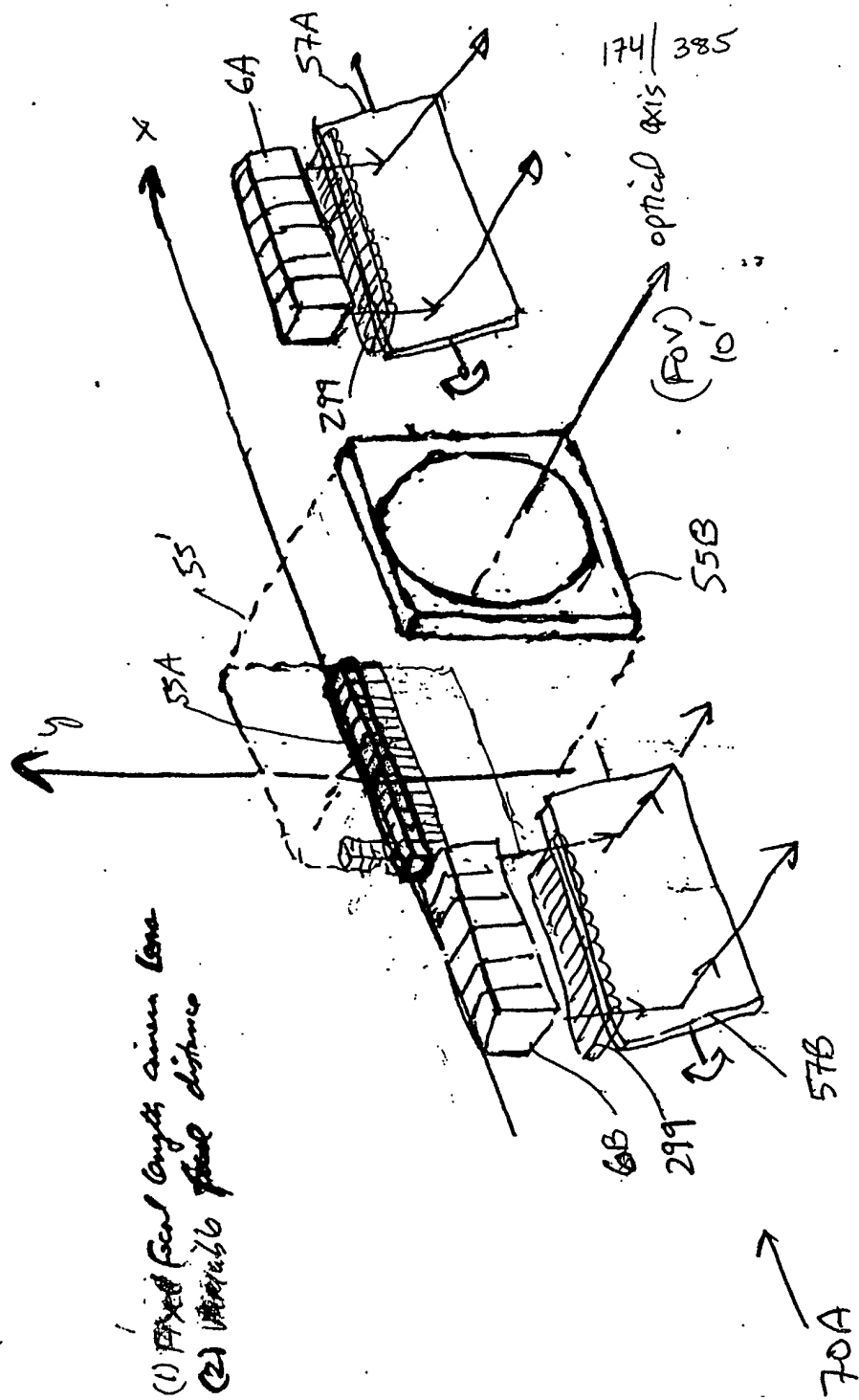


FIG. 5B2



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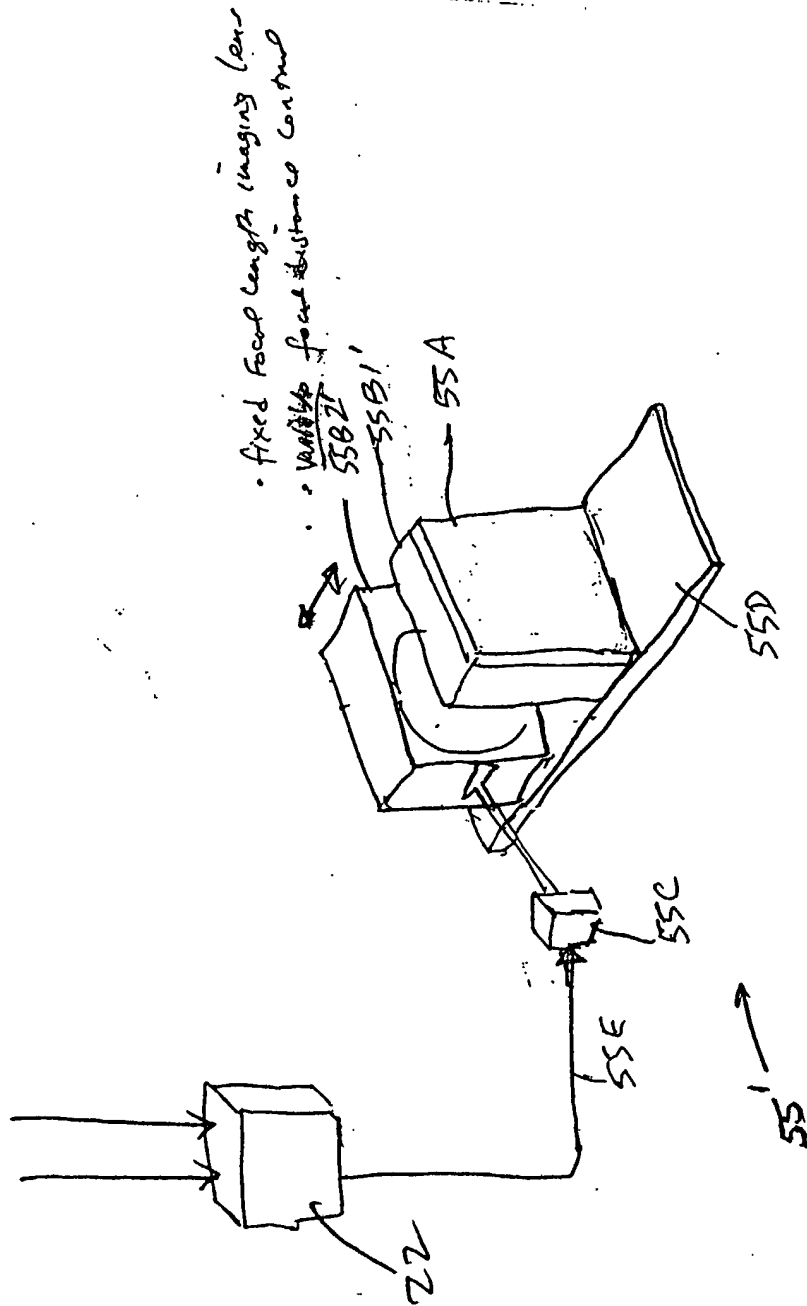


FIG. 5B4

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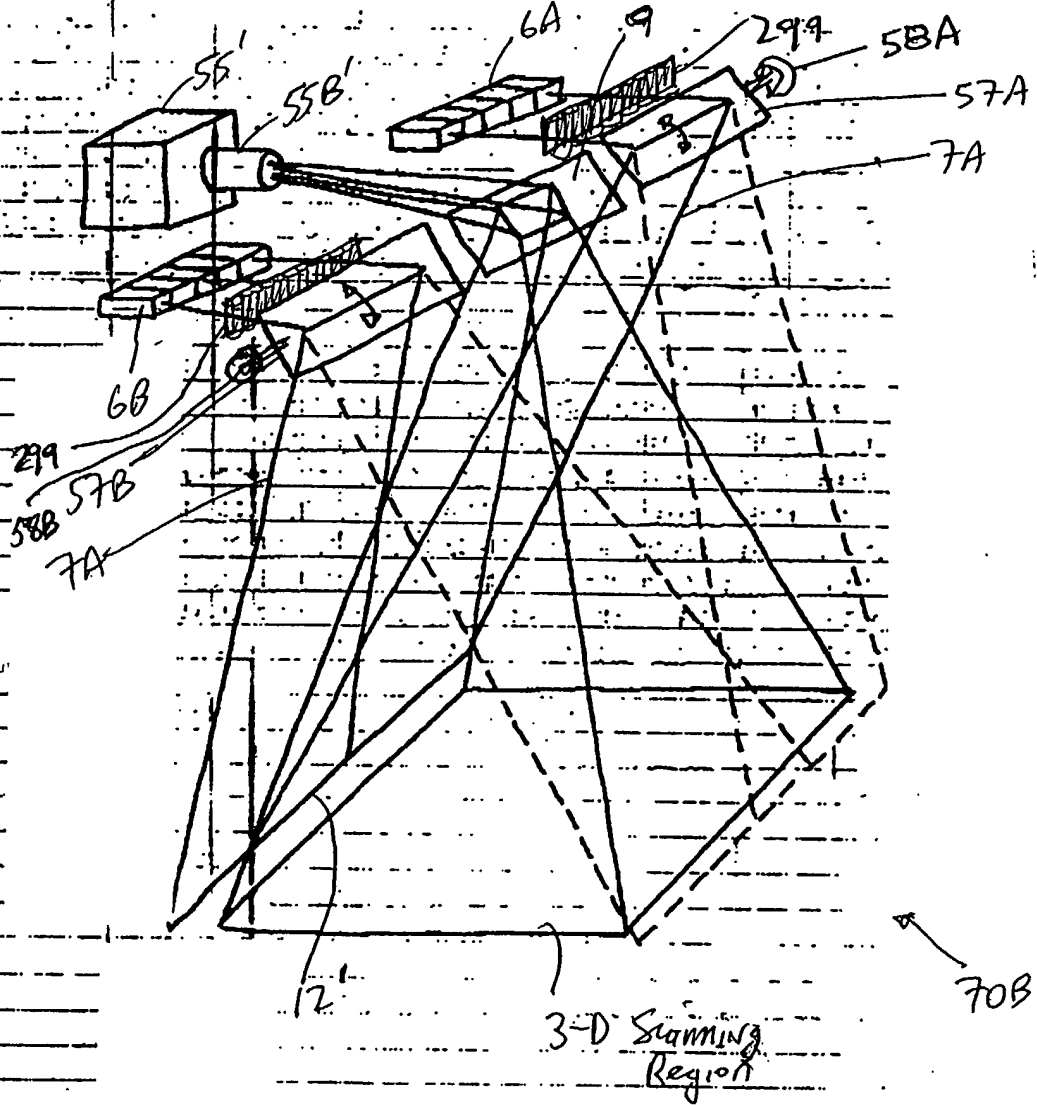
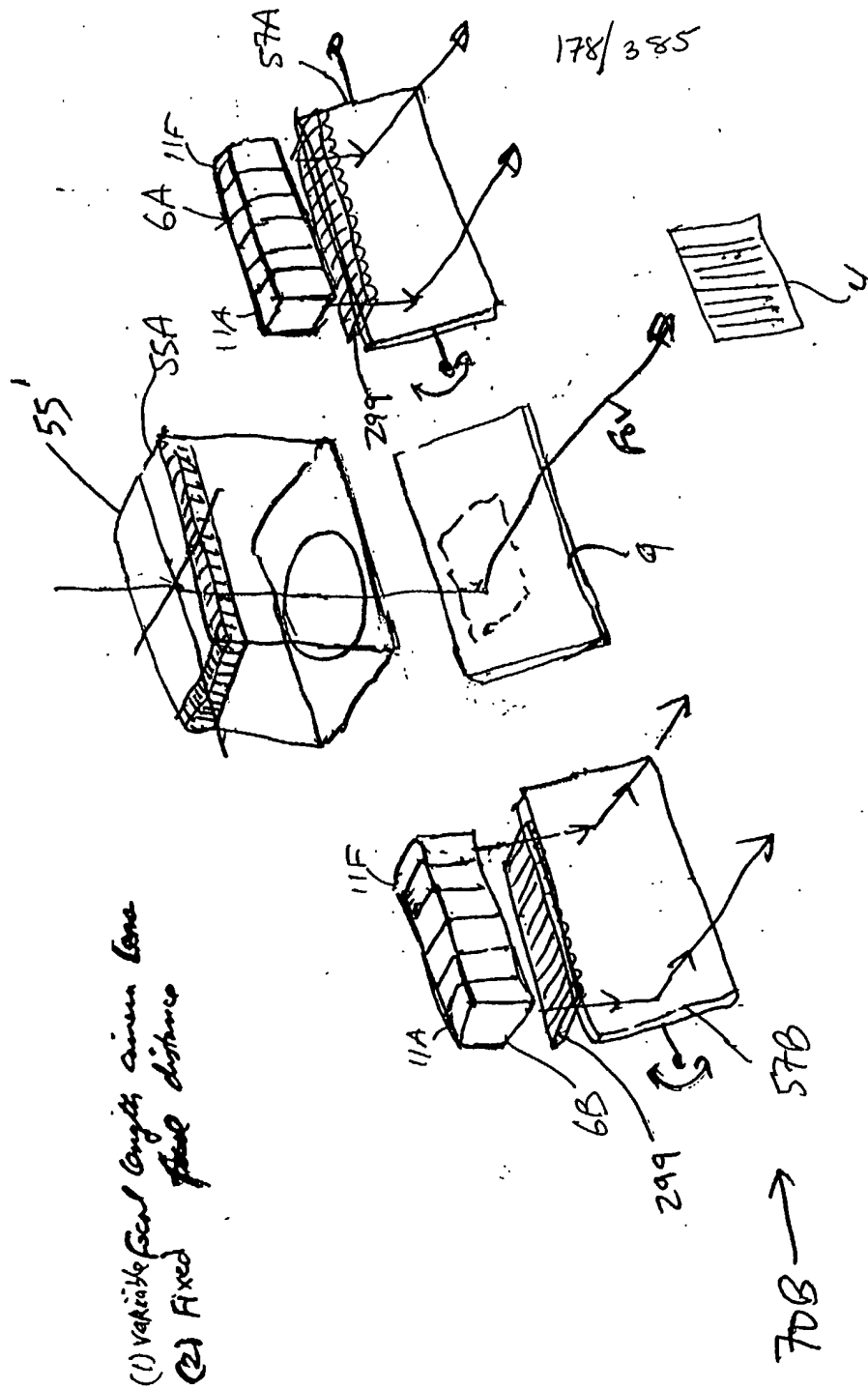


FIG. 5C1



(1) Variable length sinus tone  
(2) Fixed peak distance

FIG. 5C

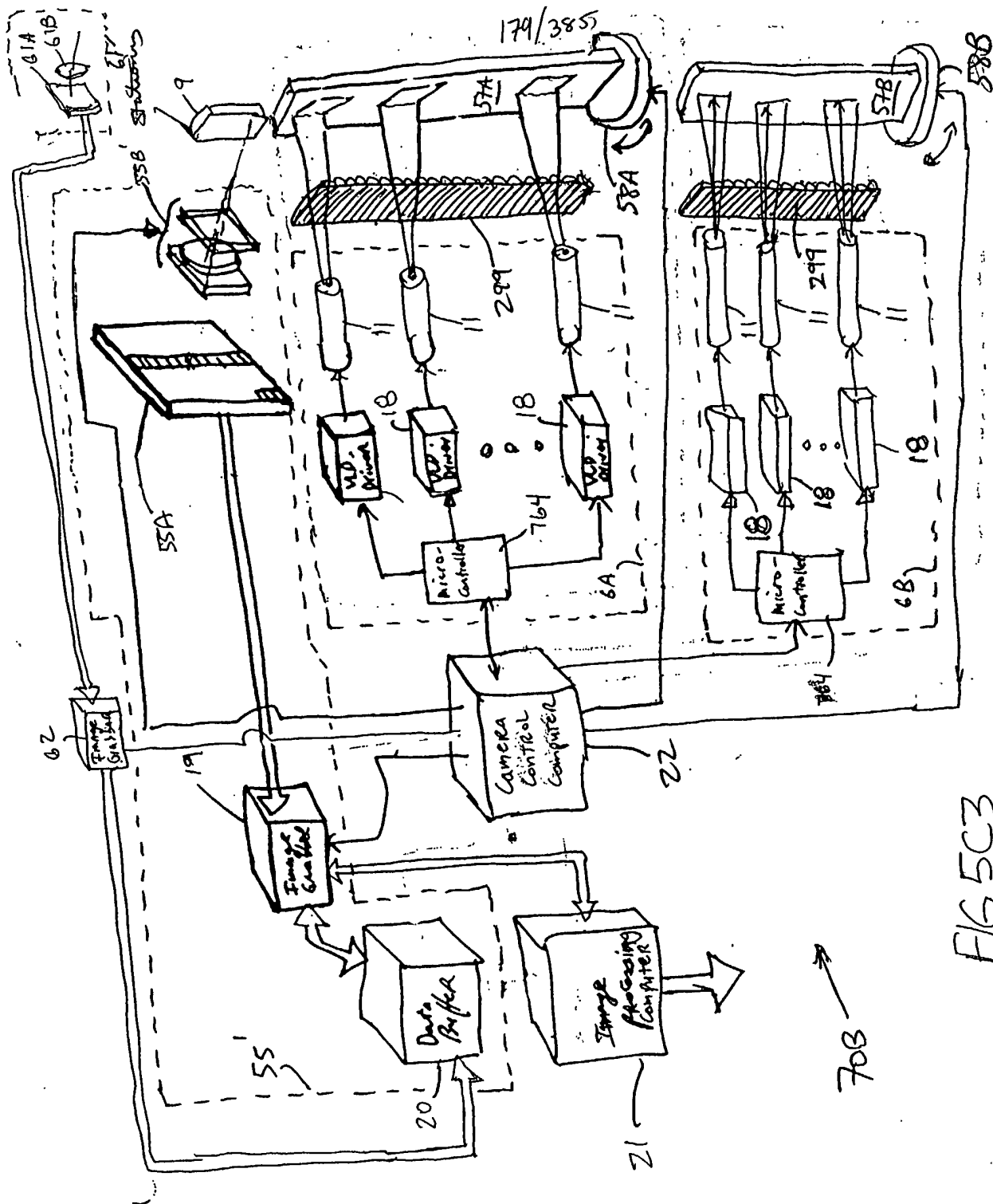


FIG. 5C3

70B

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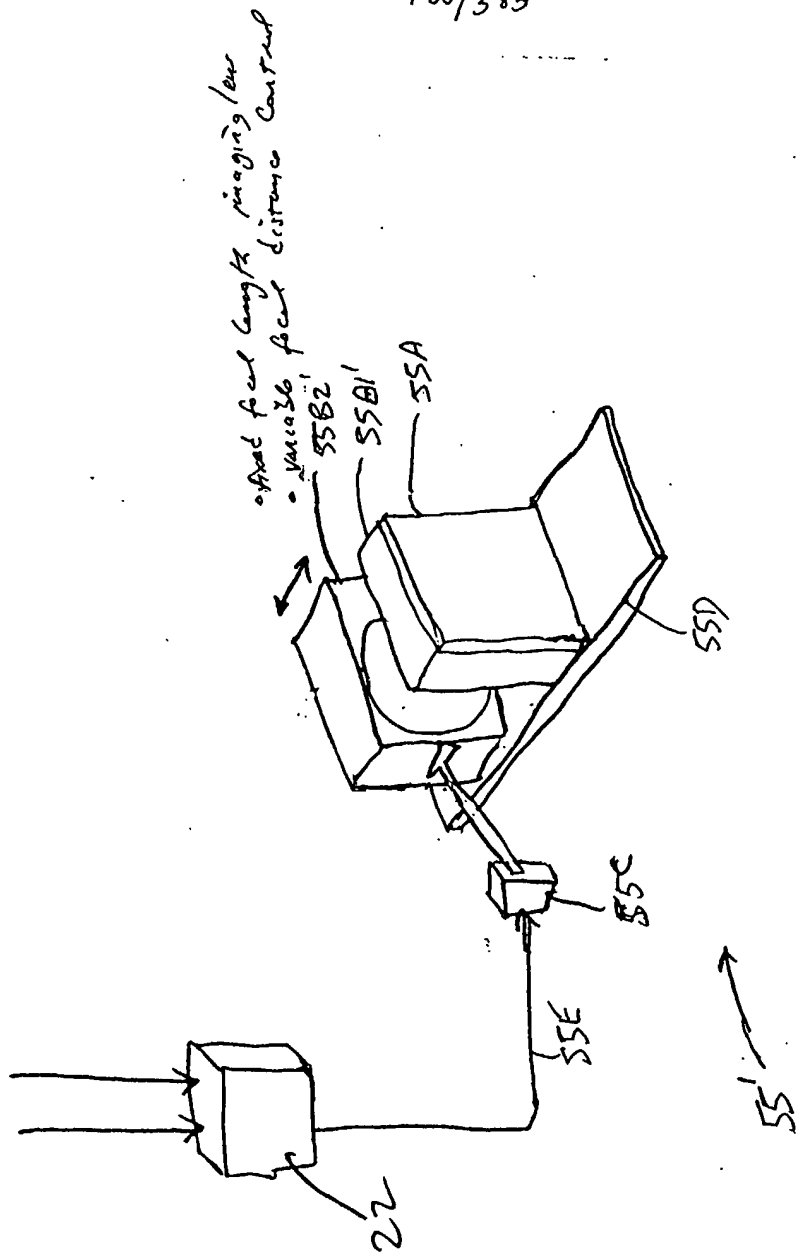


FIG. 5C4



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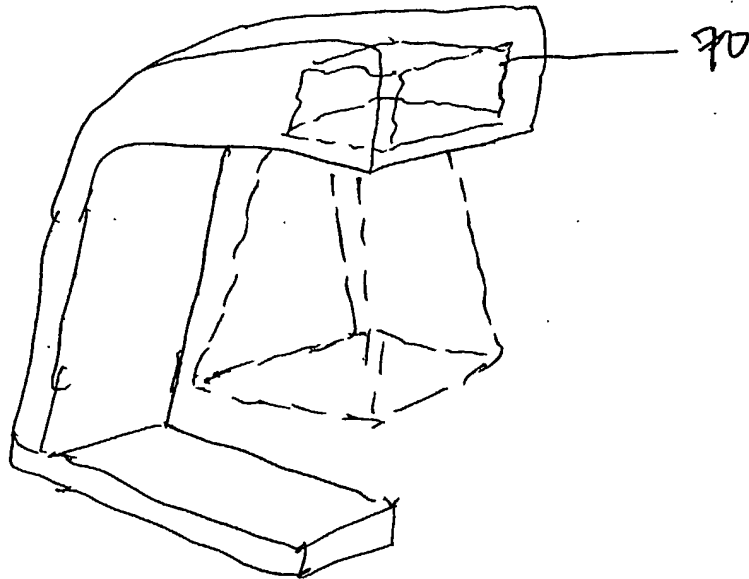


FIG. 5D

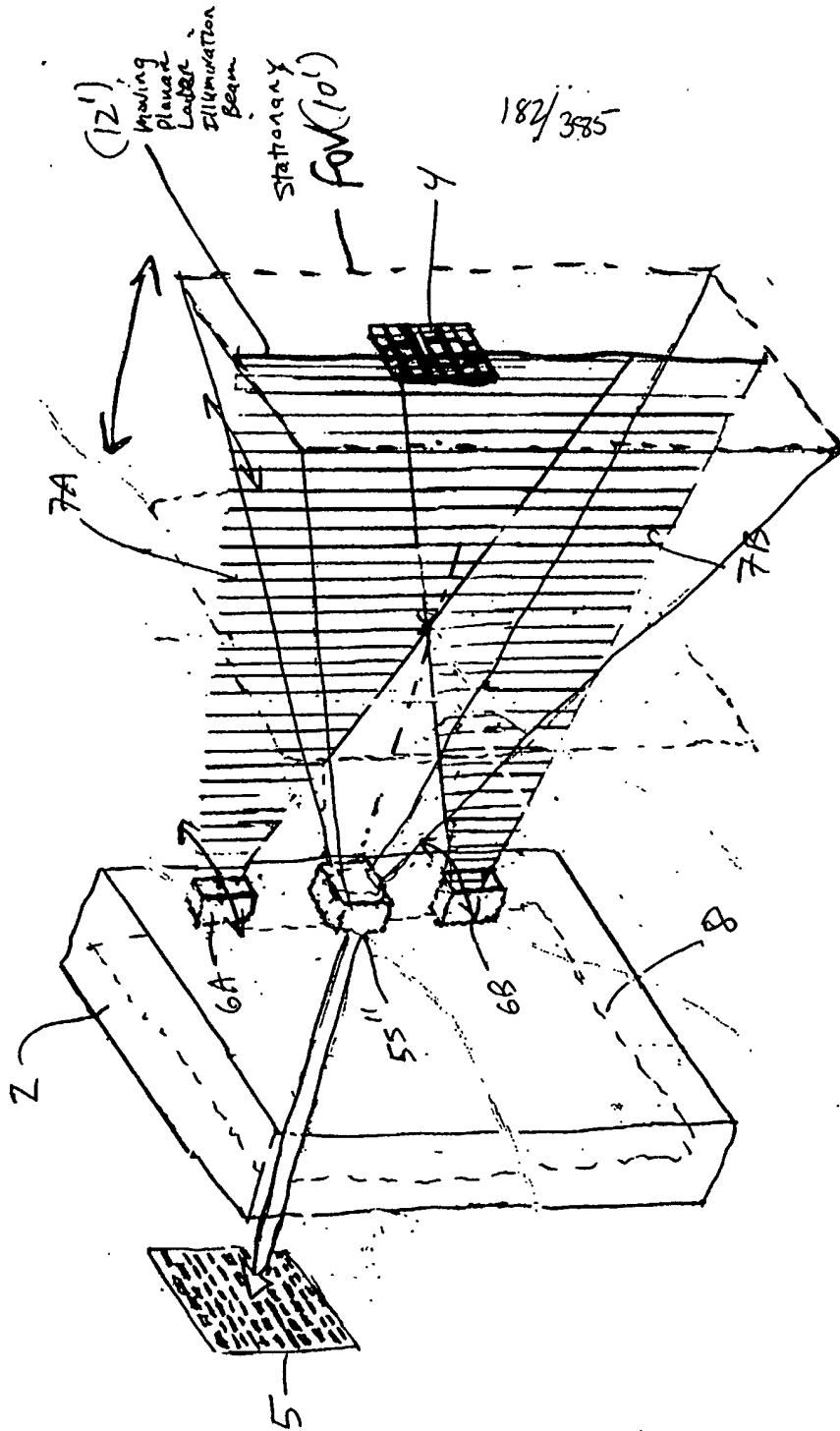


FIG. 6A

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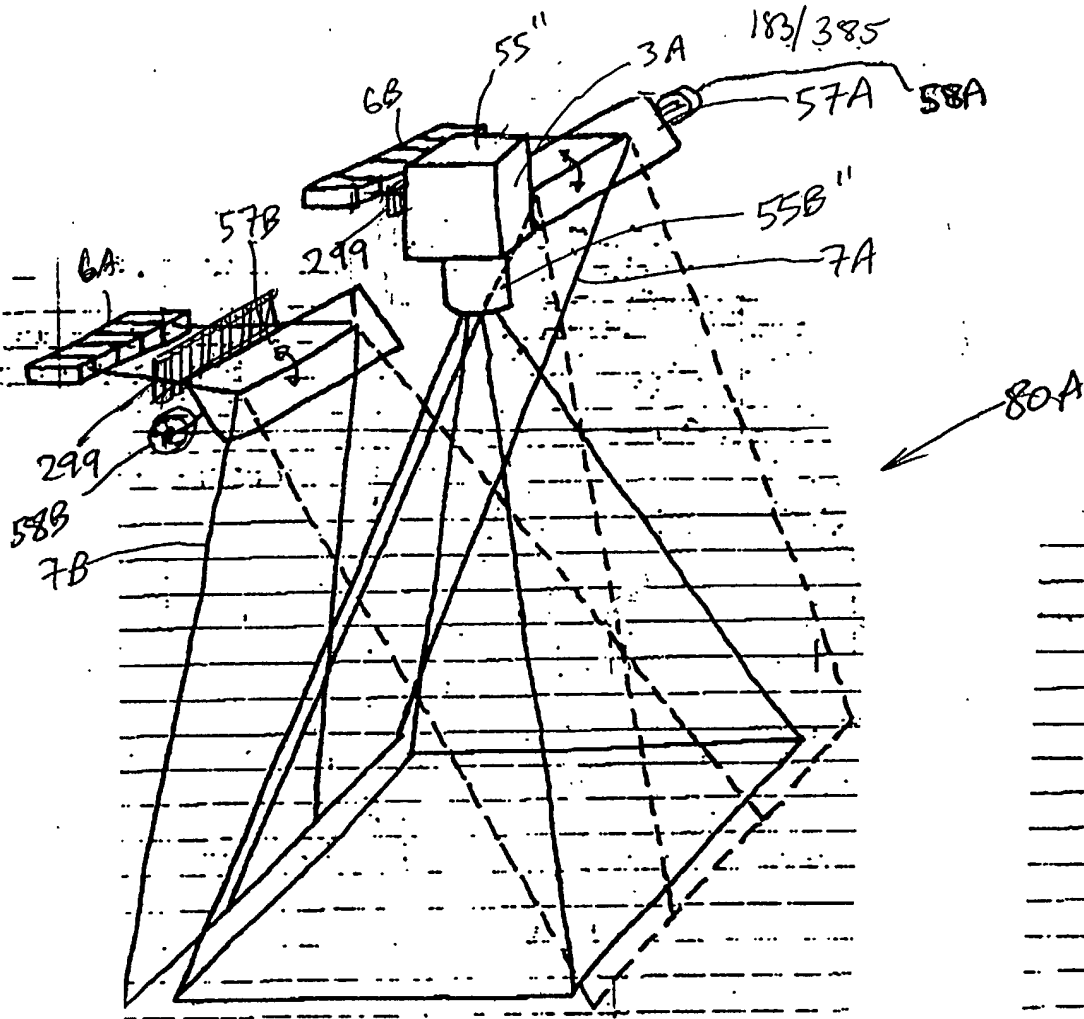
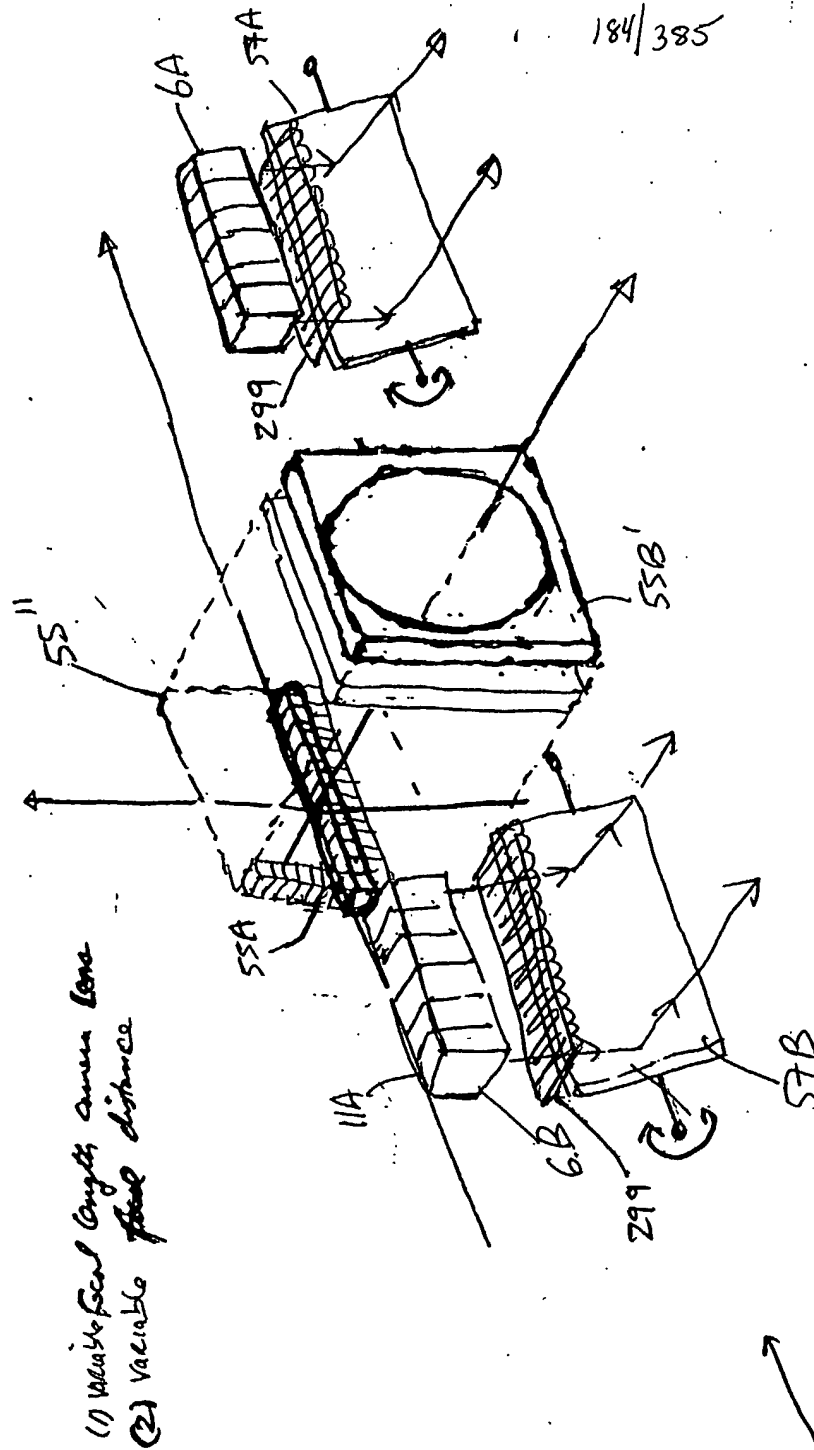


FIG. 6B1



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FIG. 6B2

- (1) Variable length annular lens
- (2) Variable fluid distance

80A

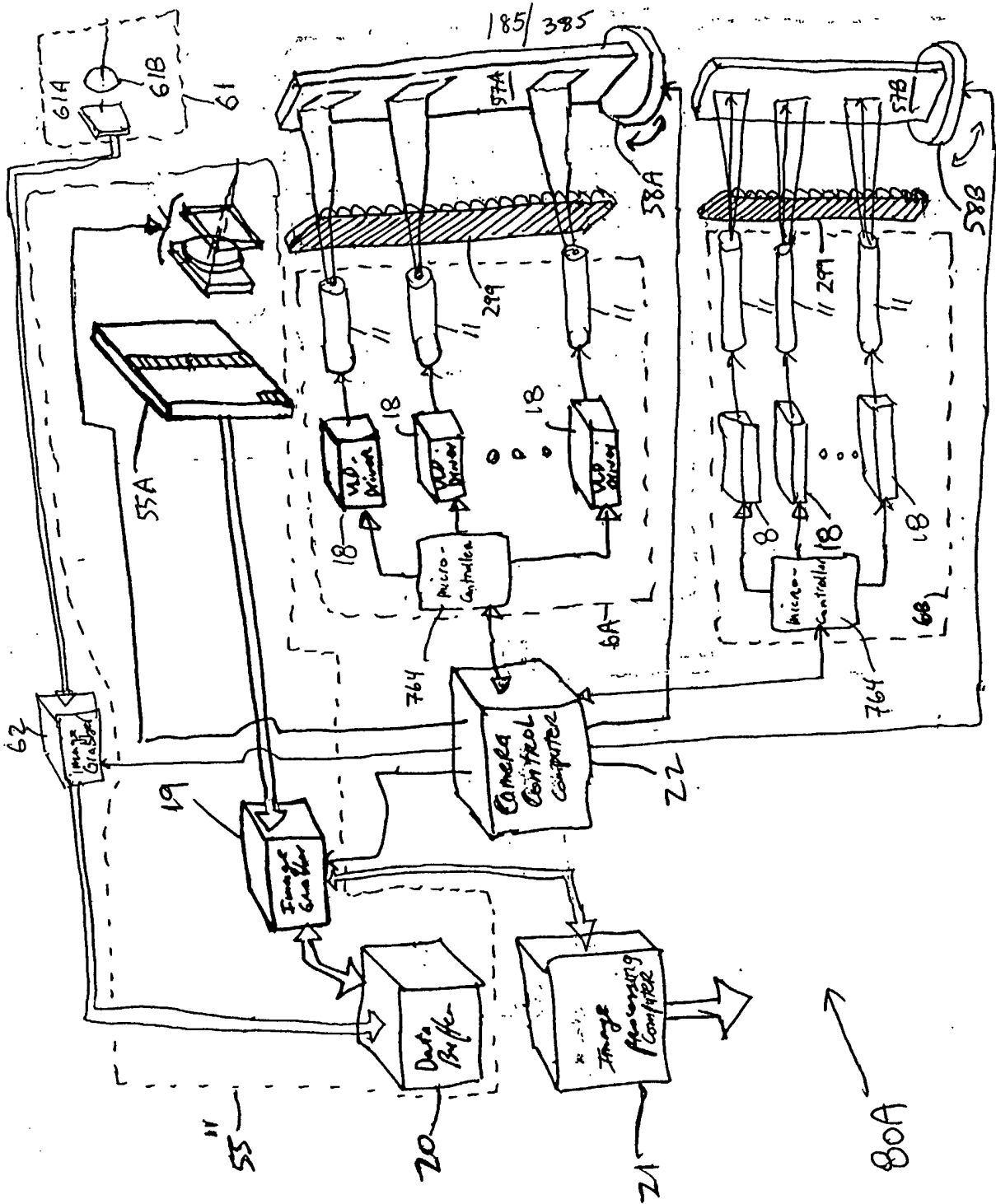


FIG. 6B3

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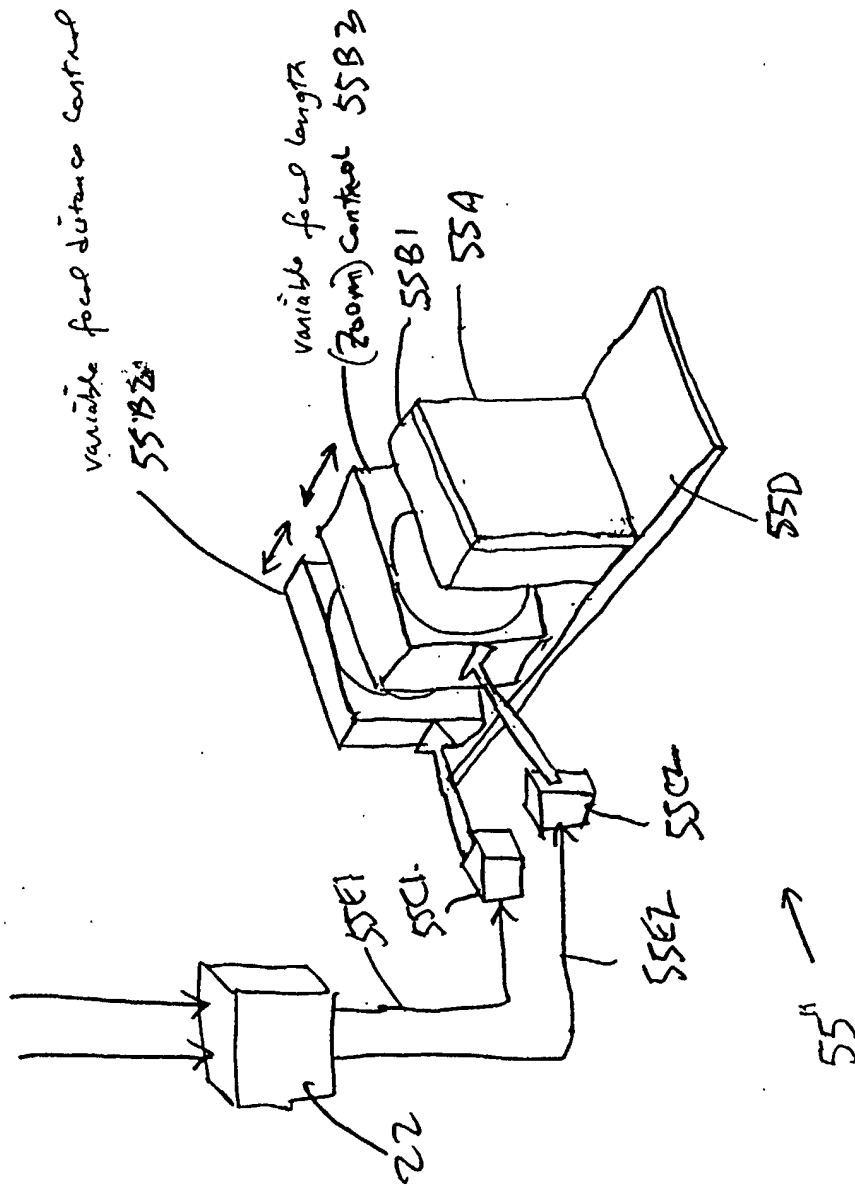


FIG. 6B4

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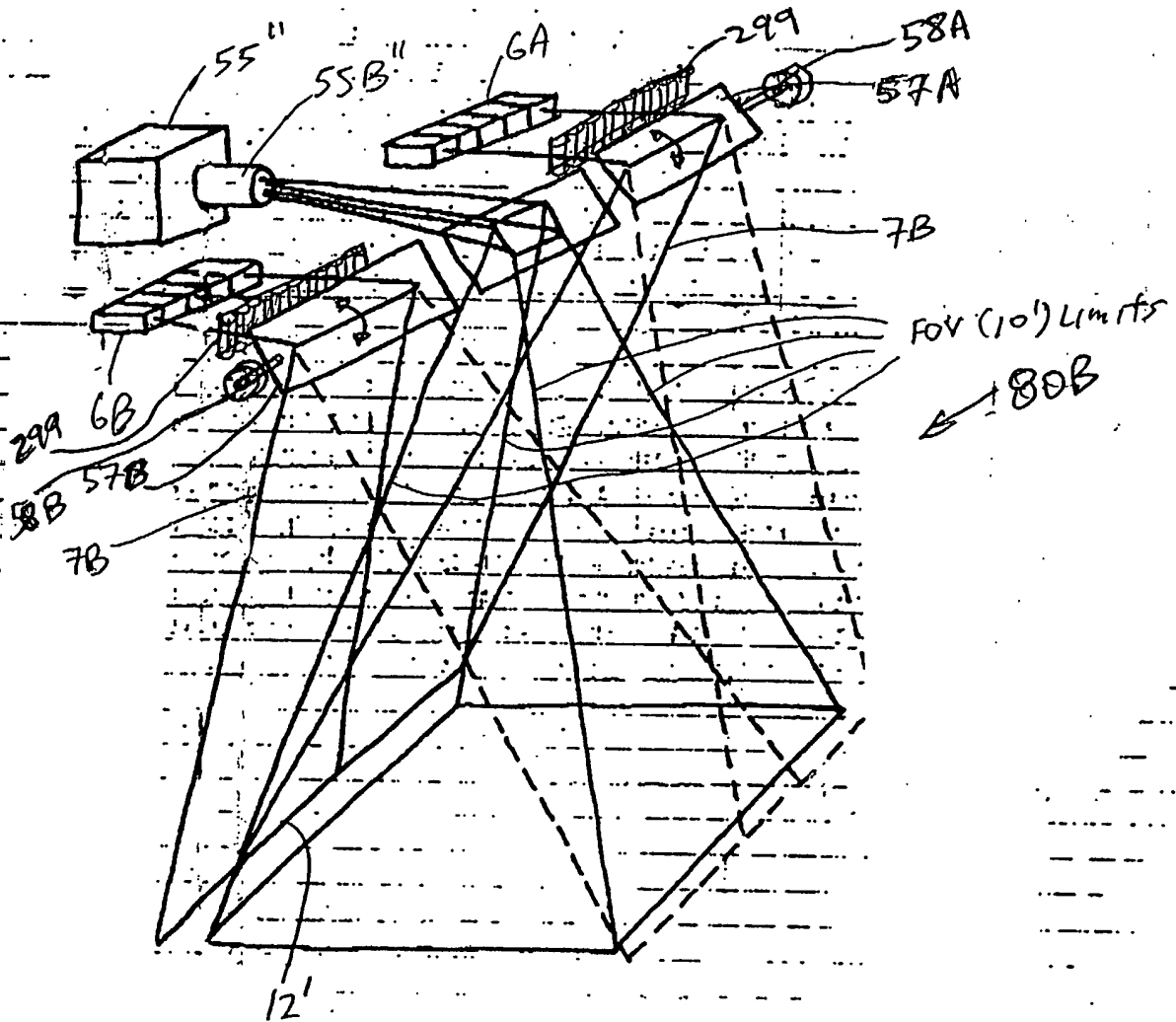
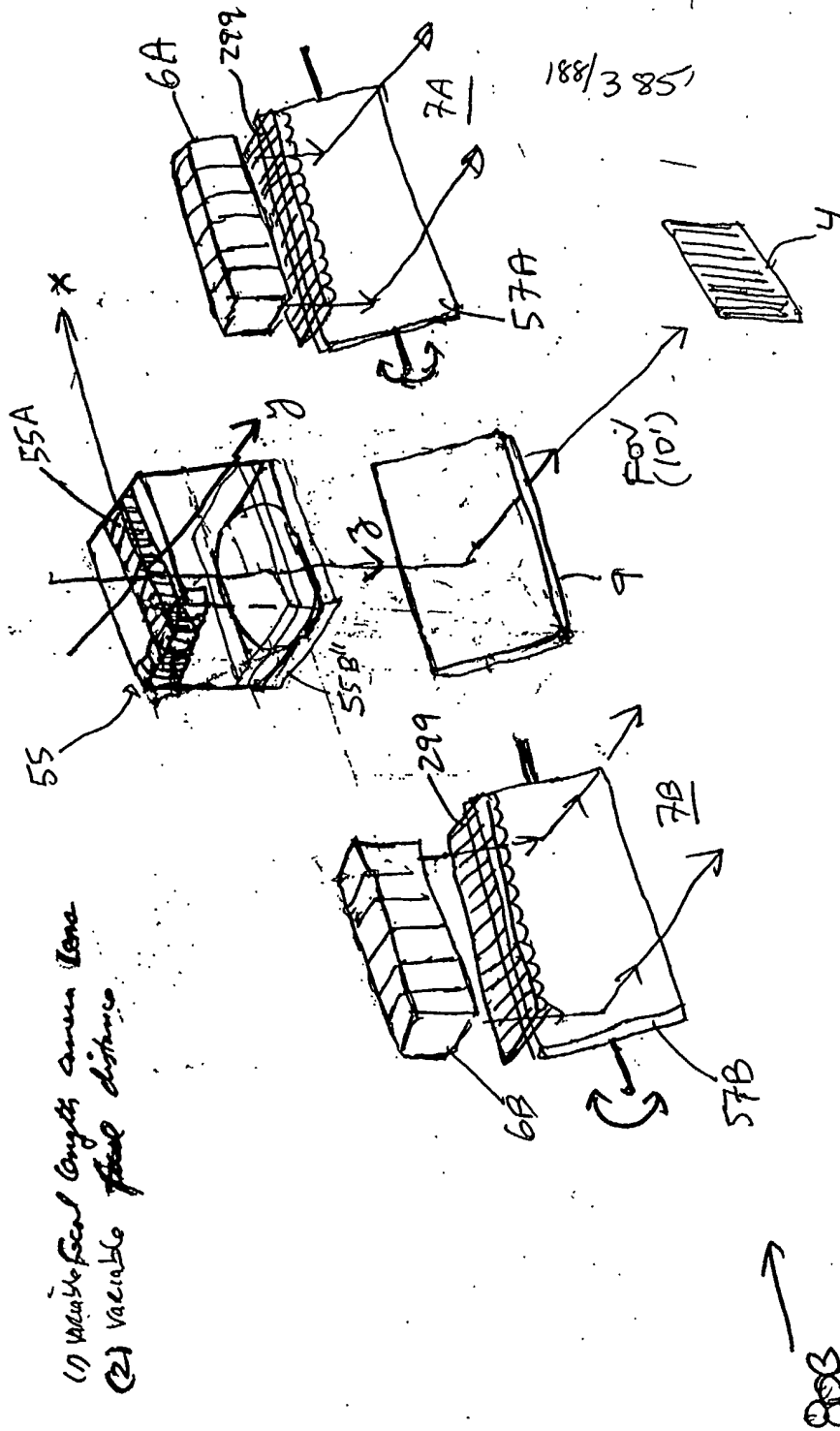


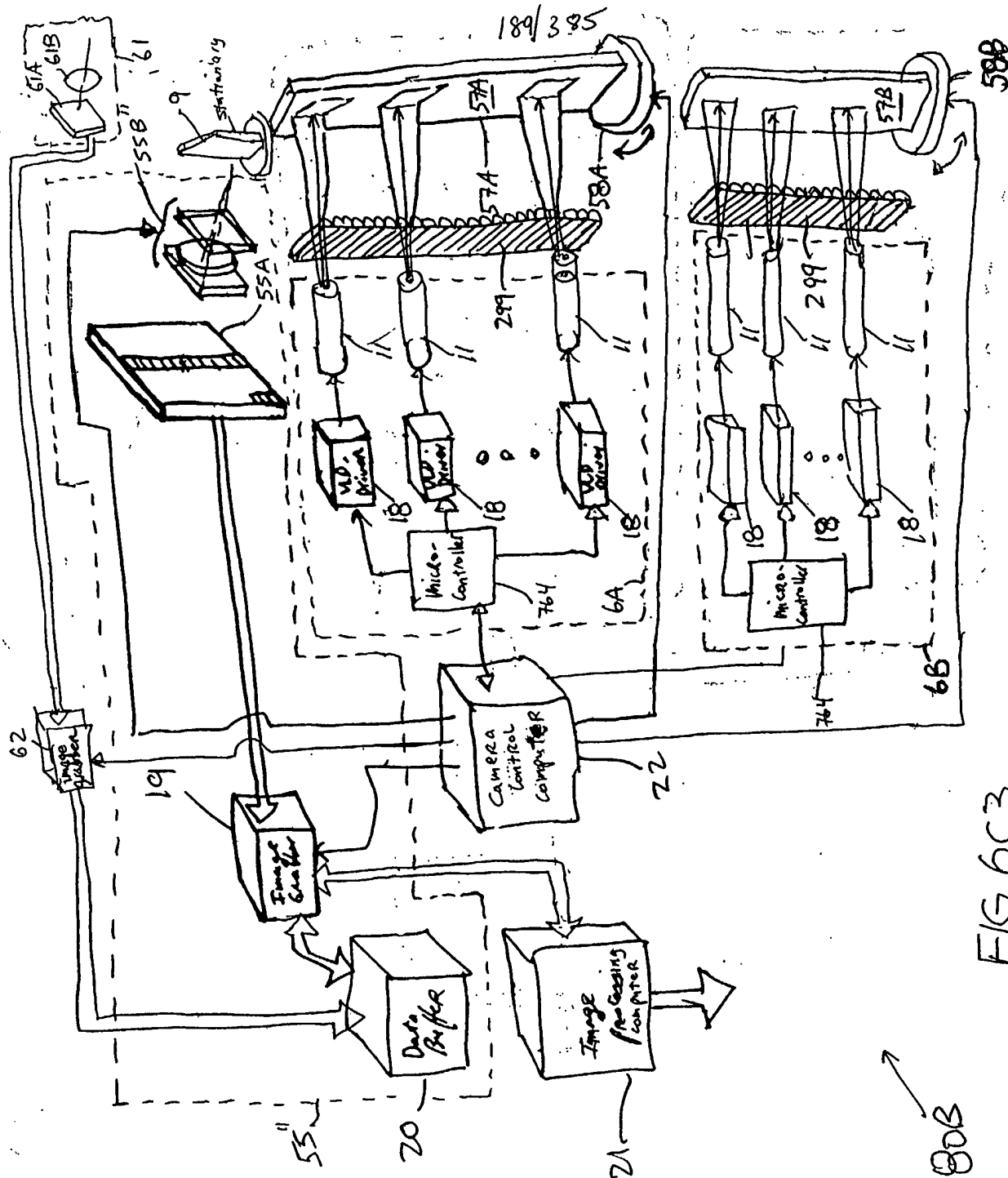
FIG. 6C1



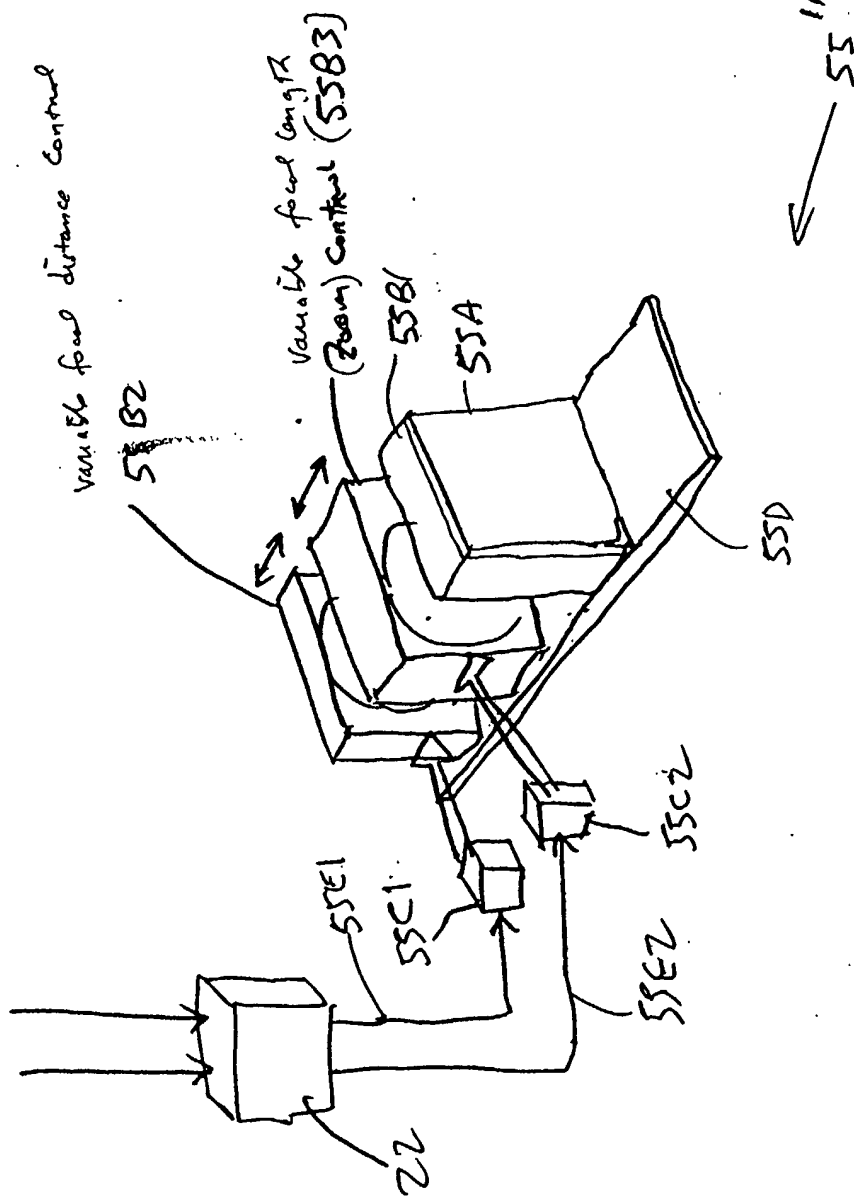
(1) Variable length inner cone  
(2) Variable fluid distance

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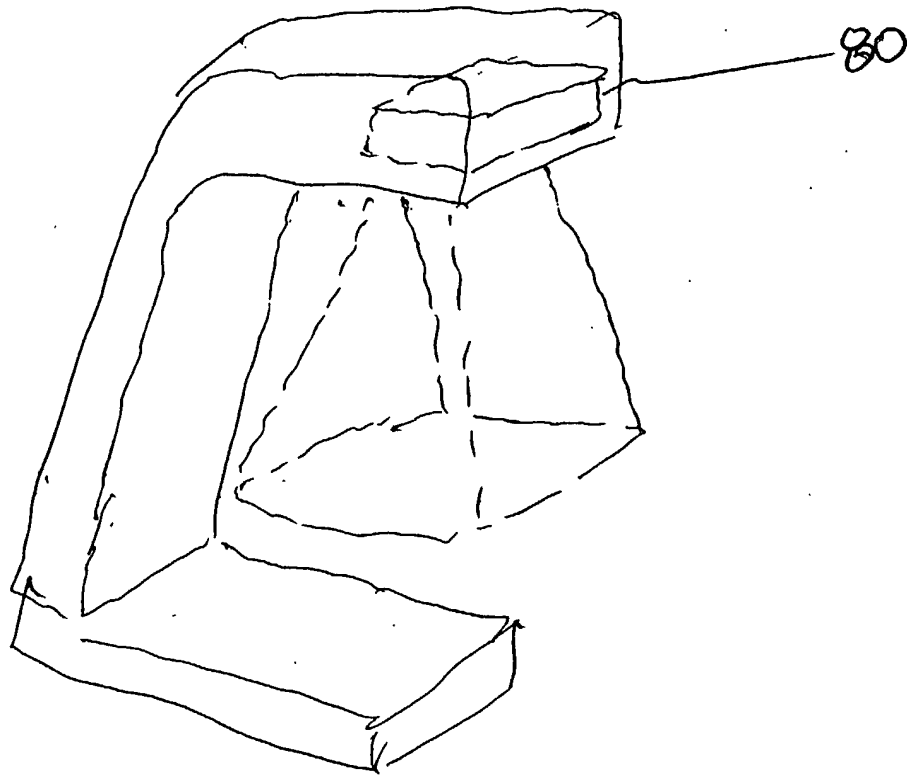


FIG. 6C5

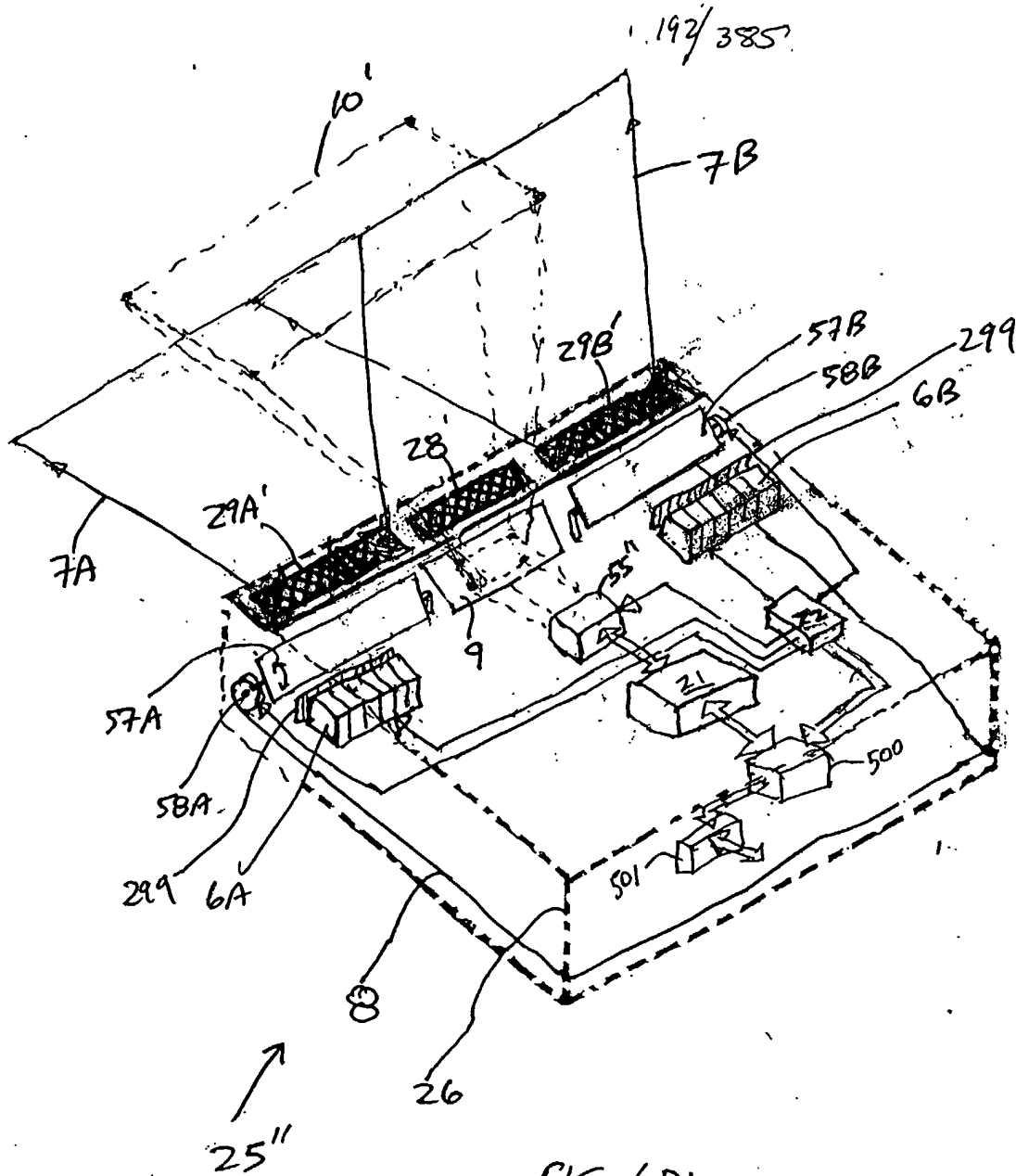


FIG. 6D1

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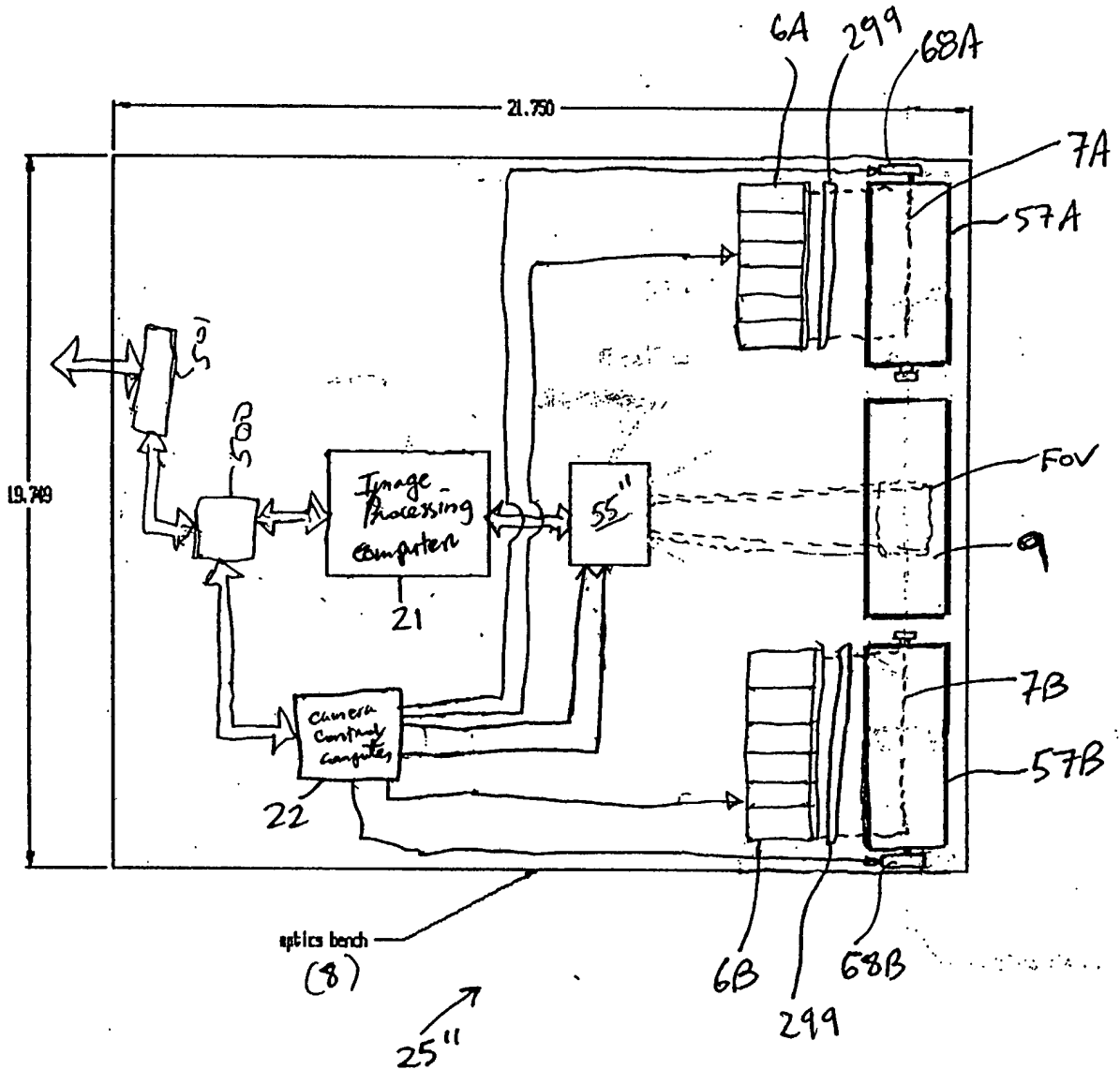
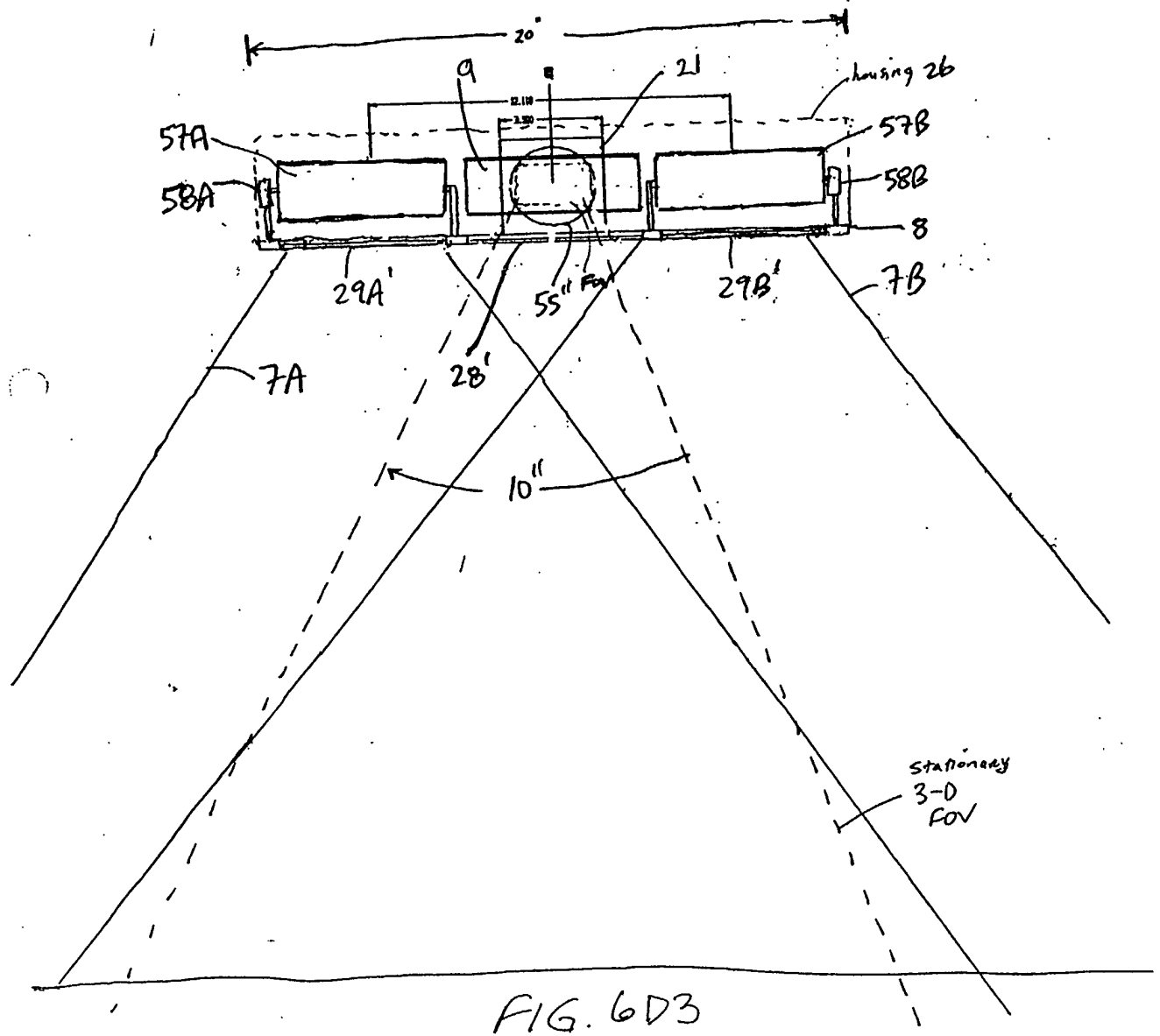


FIG. 6DZ

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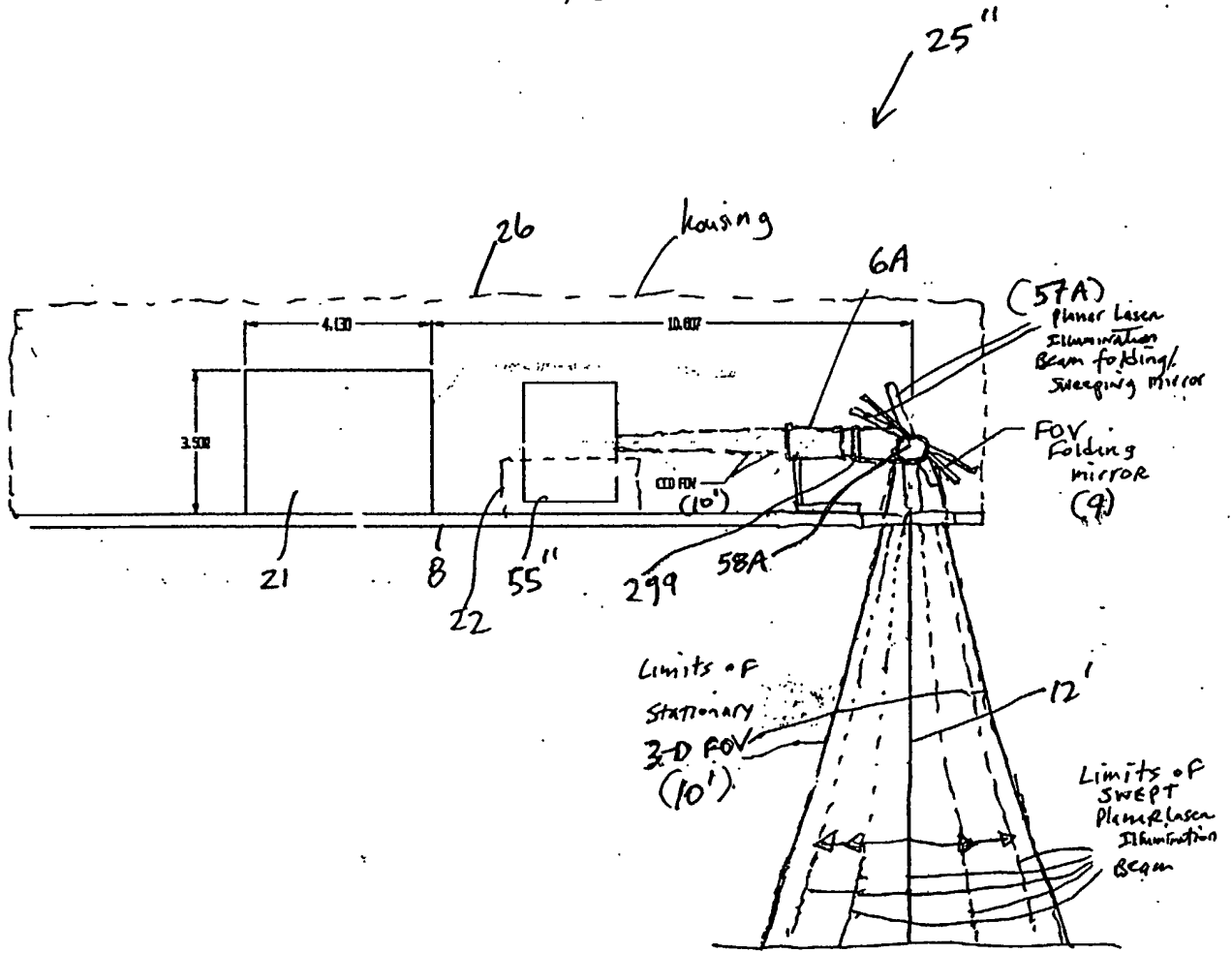


FIG. 6D4

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Variable FOV

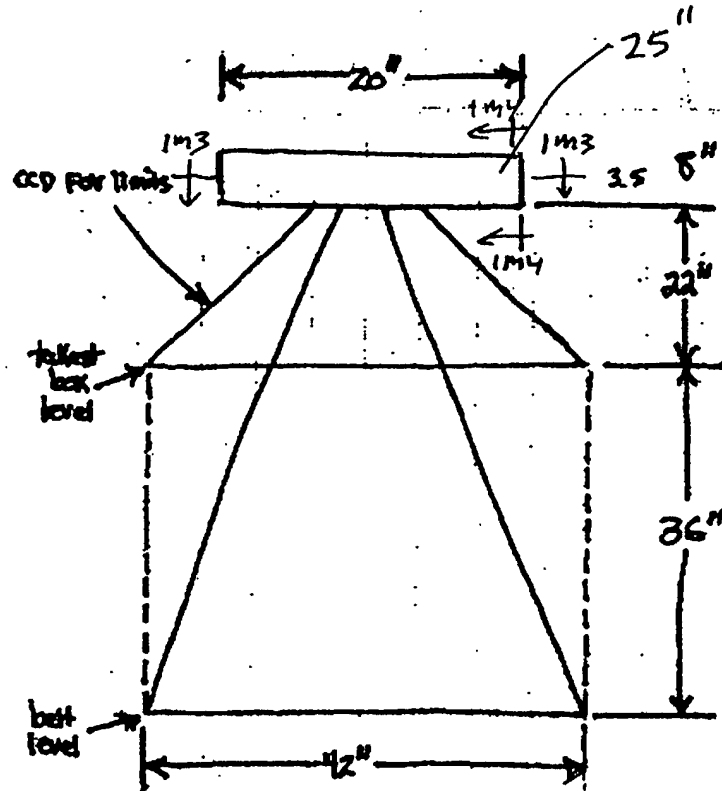


FIG. 6D5



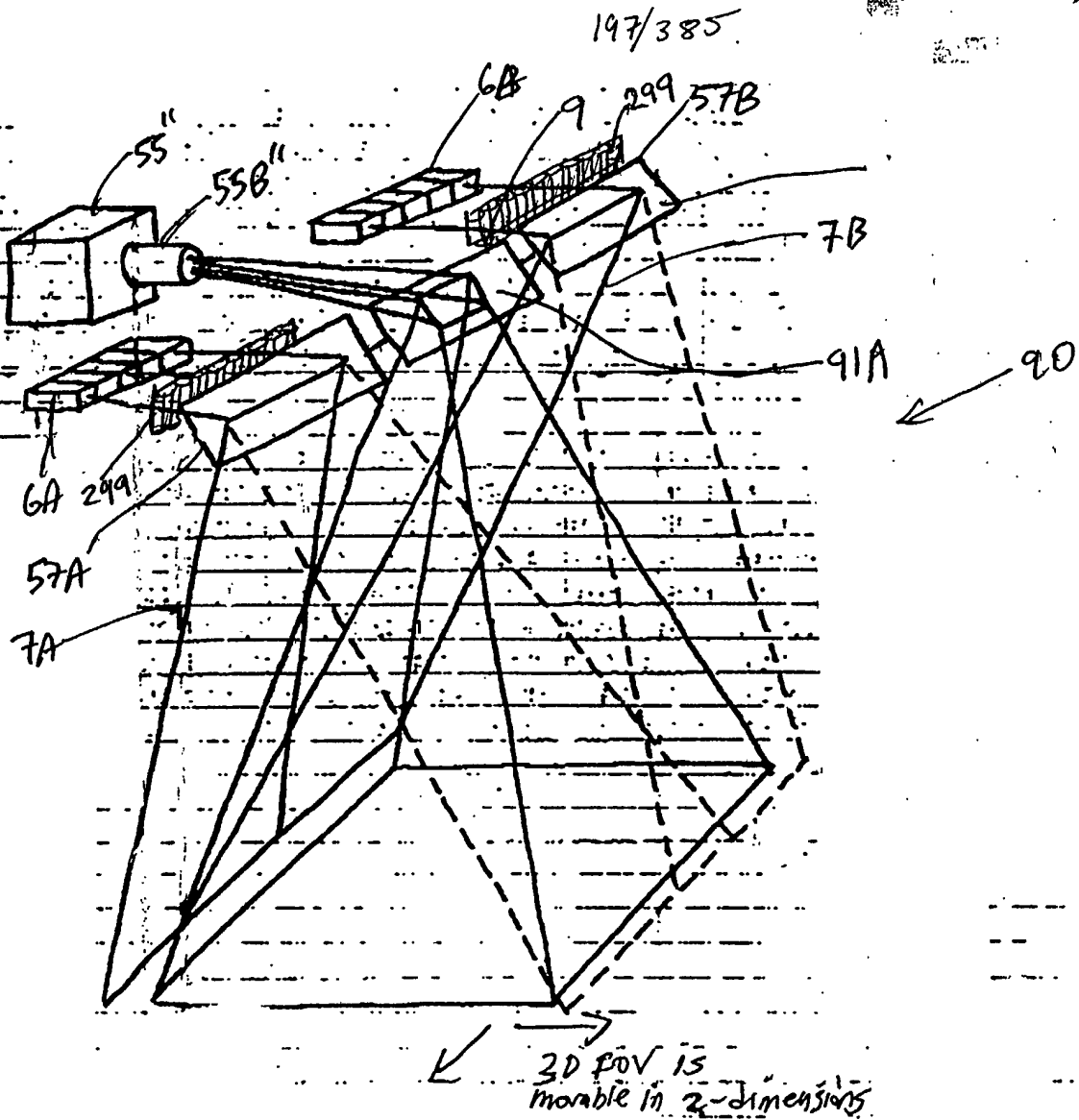


FIG 6E1

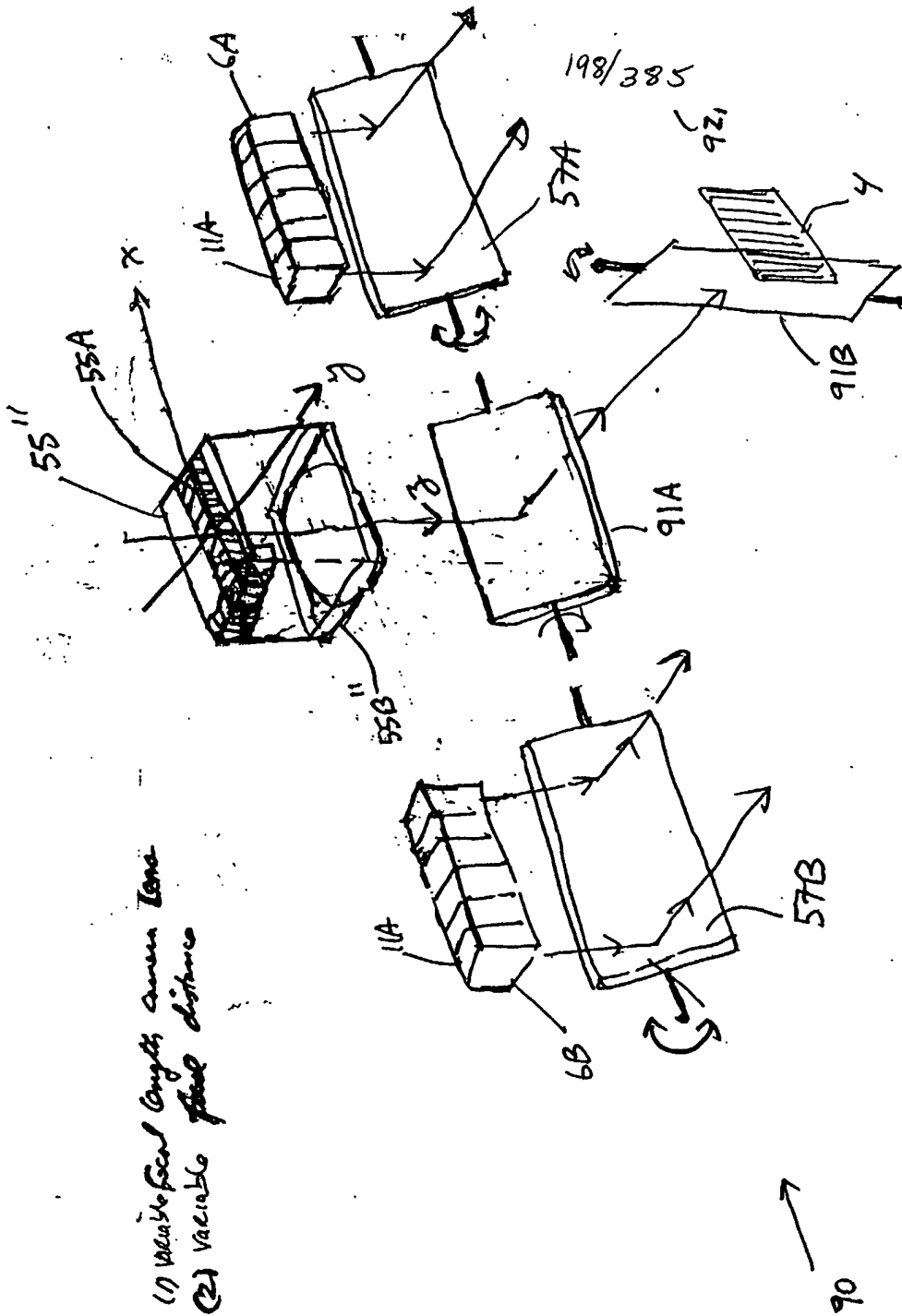


FIG. 6E2

(1) Variable length array sensor  
(2) Variable fluid distance

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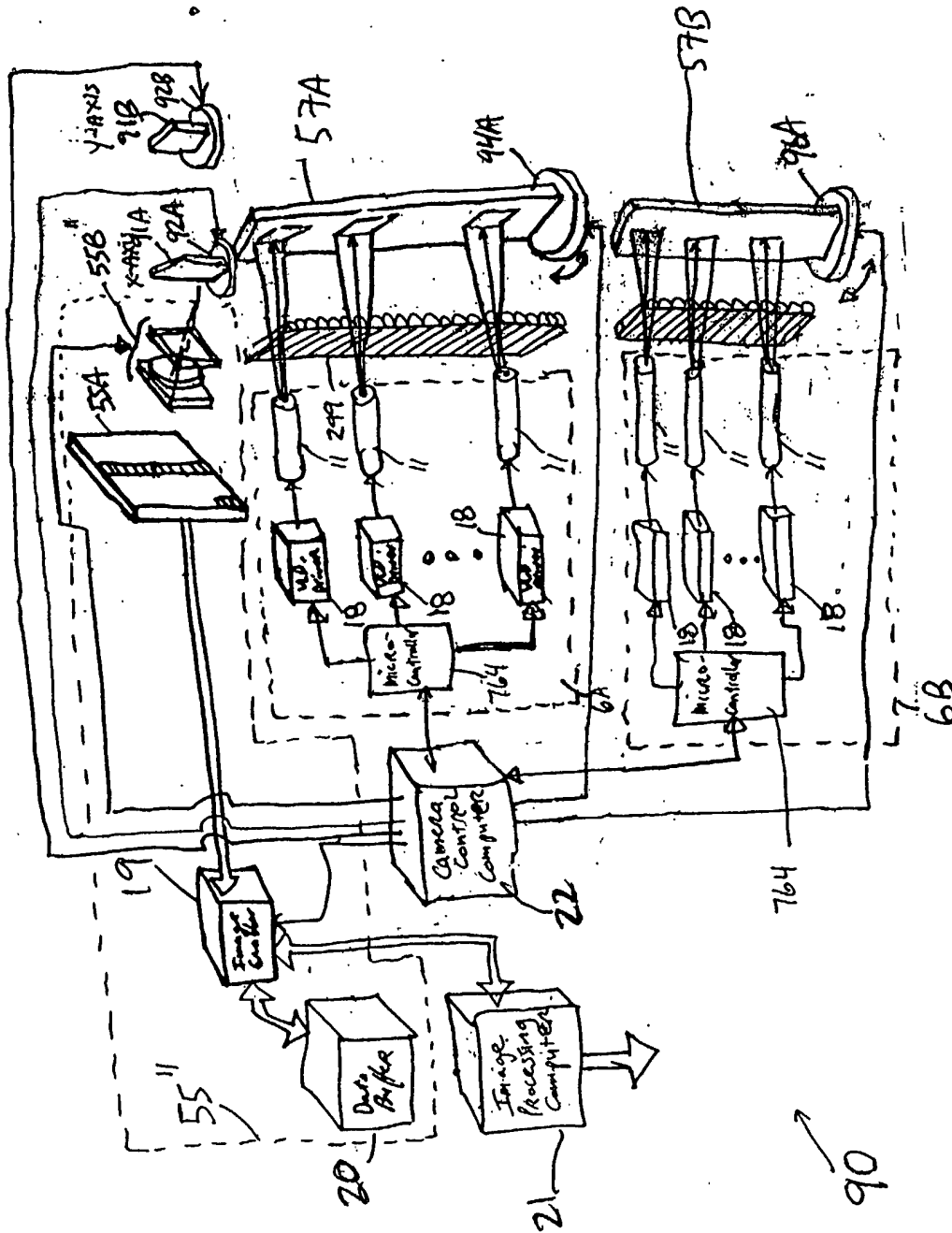
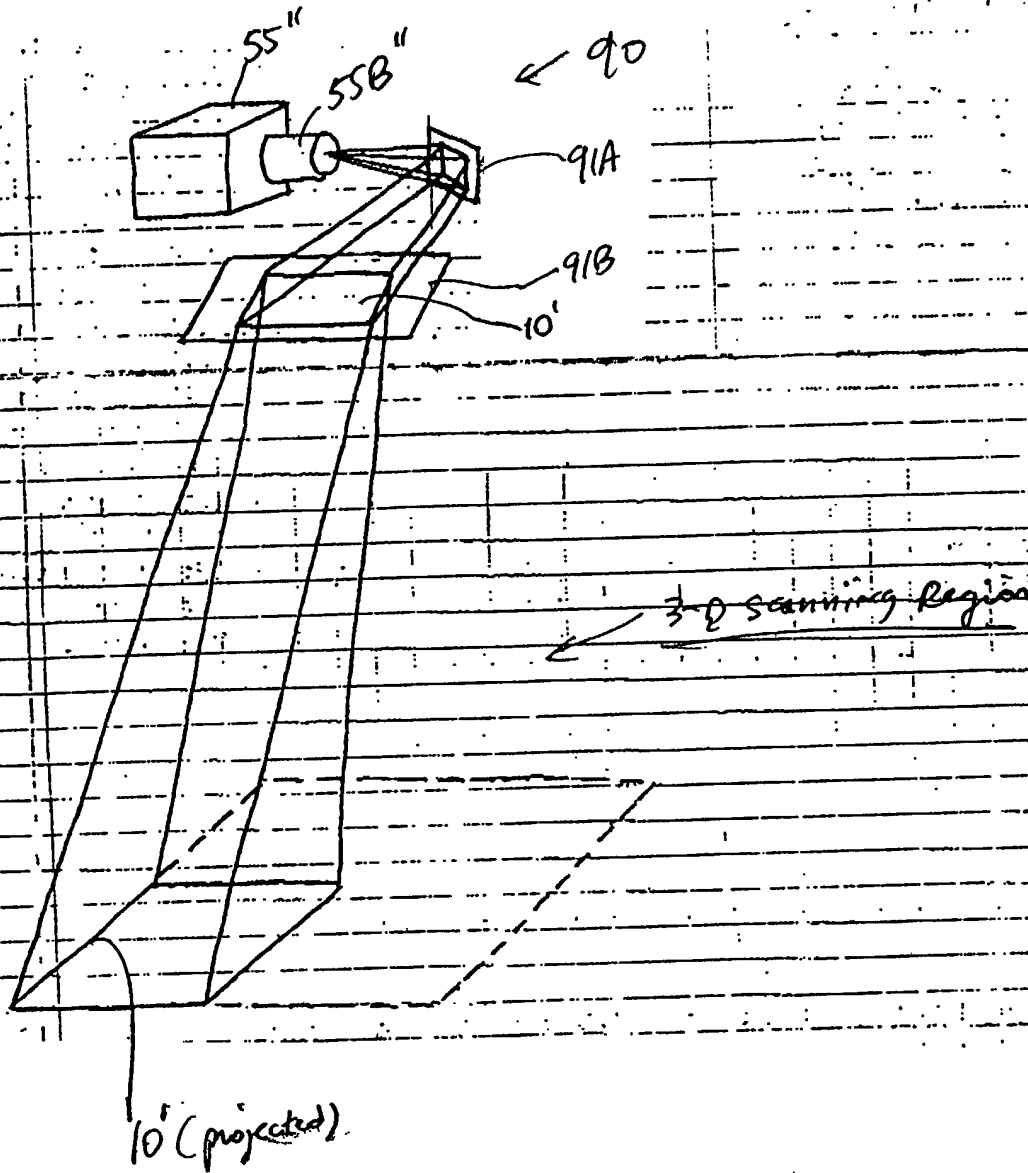
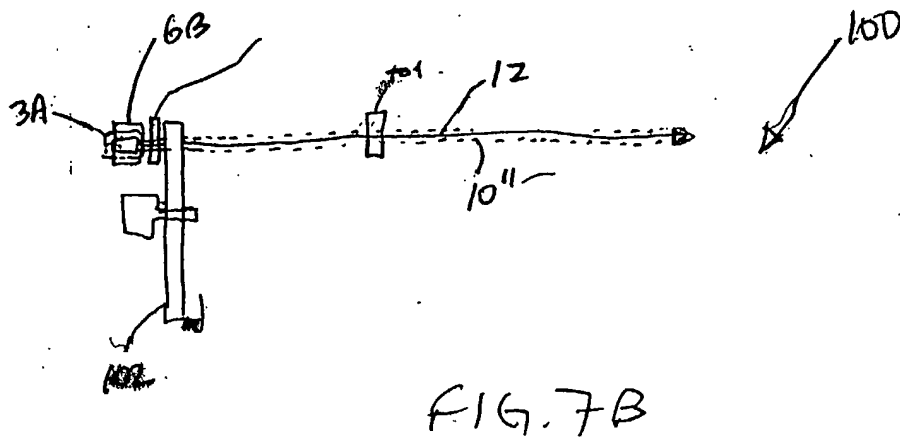
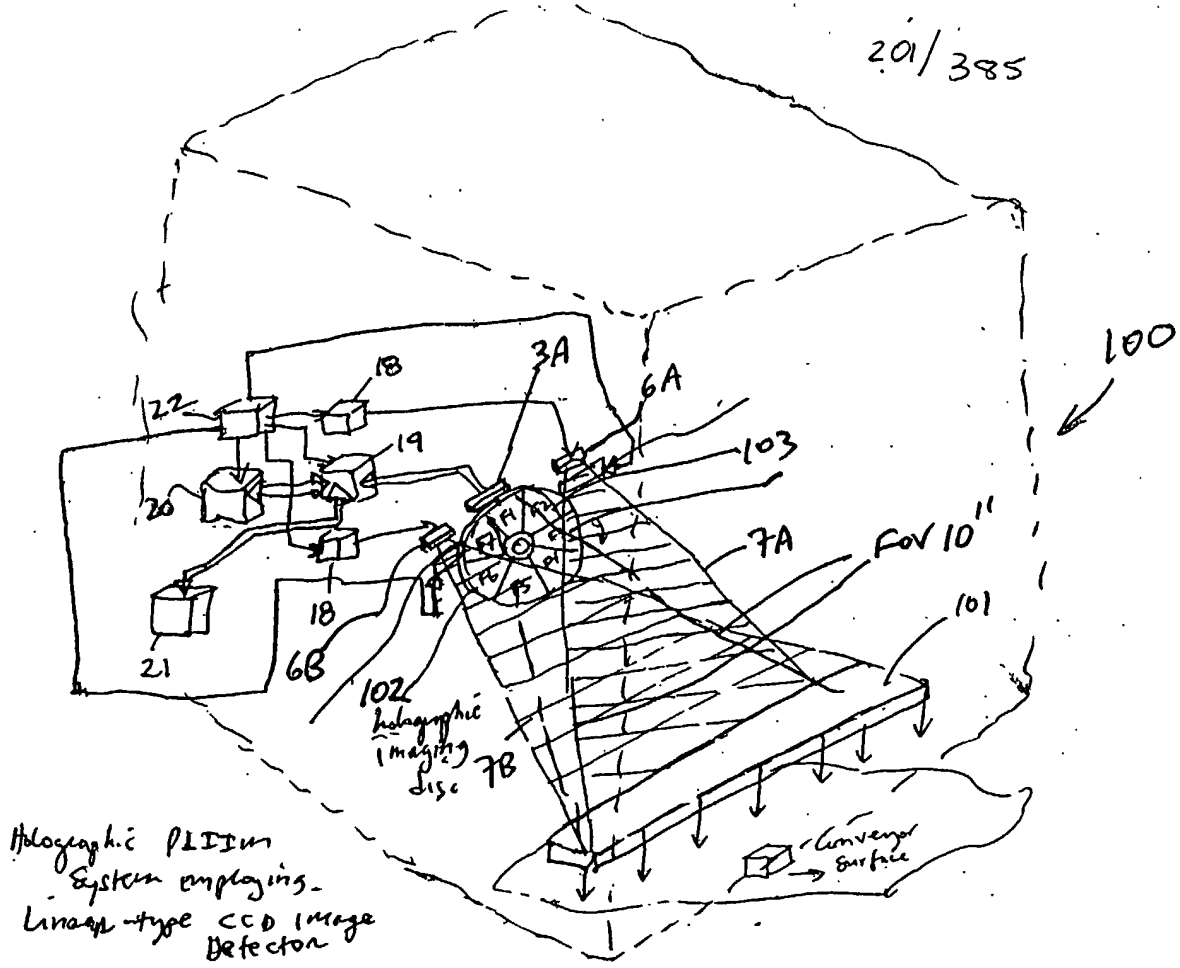


FIG. 6E3

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— FIG. 6E4



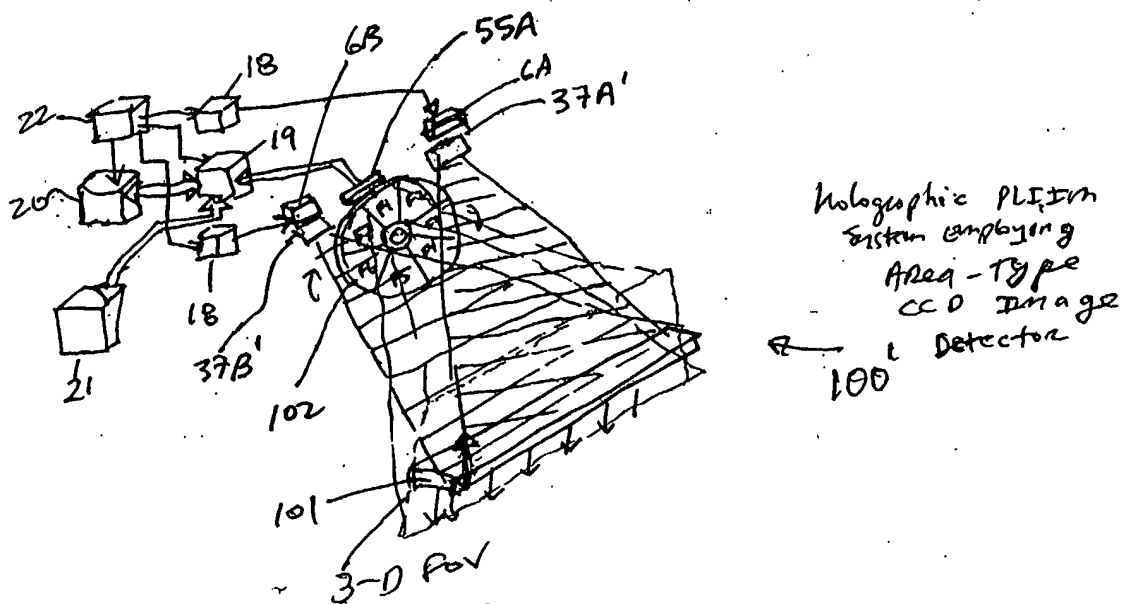
$$202/385$$


FIG. 8A

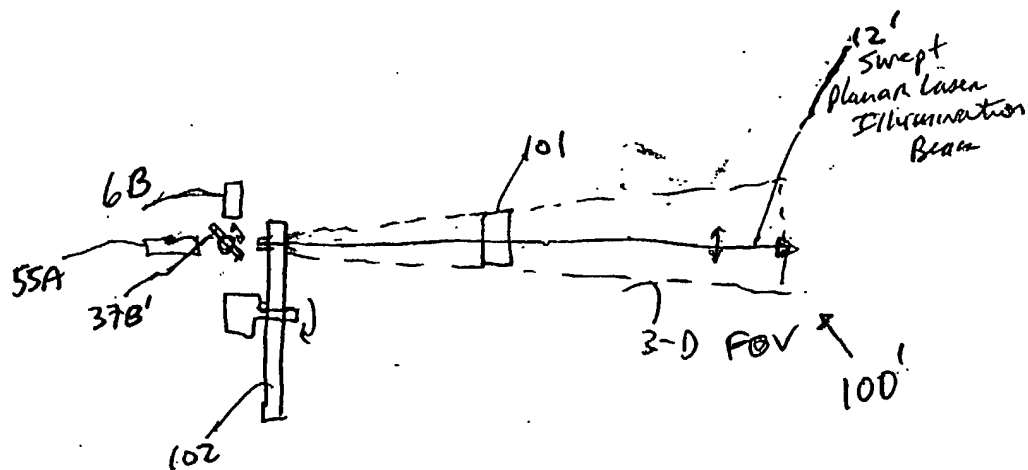


FIG. 8B

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## 1-D CCD SCANNER EMBODIMENT

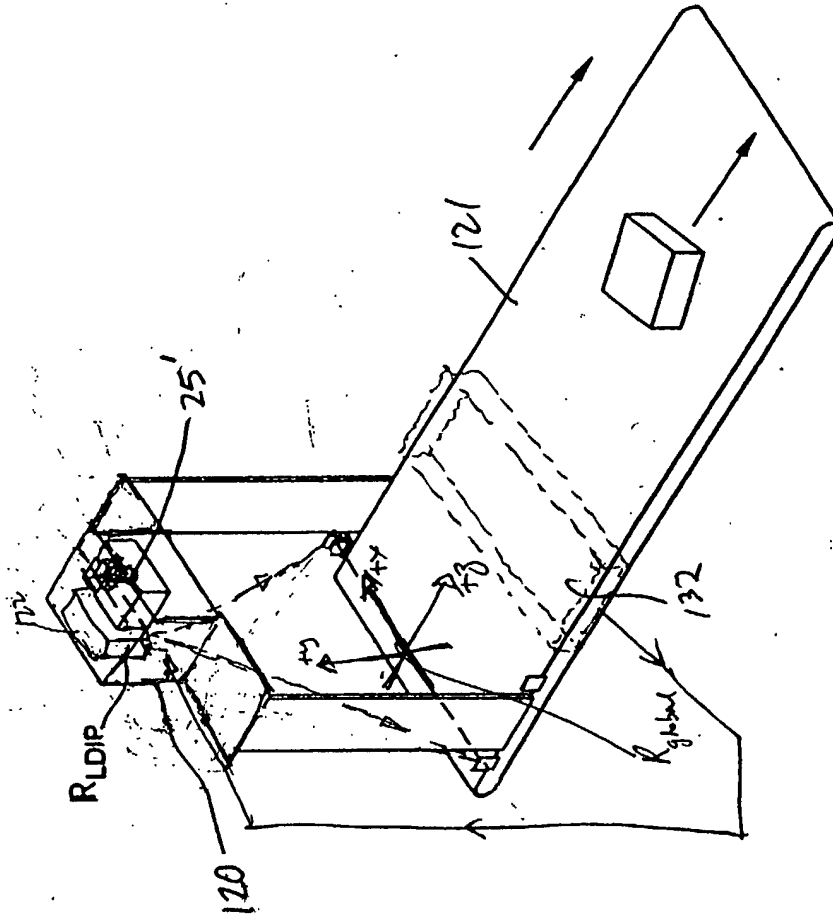
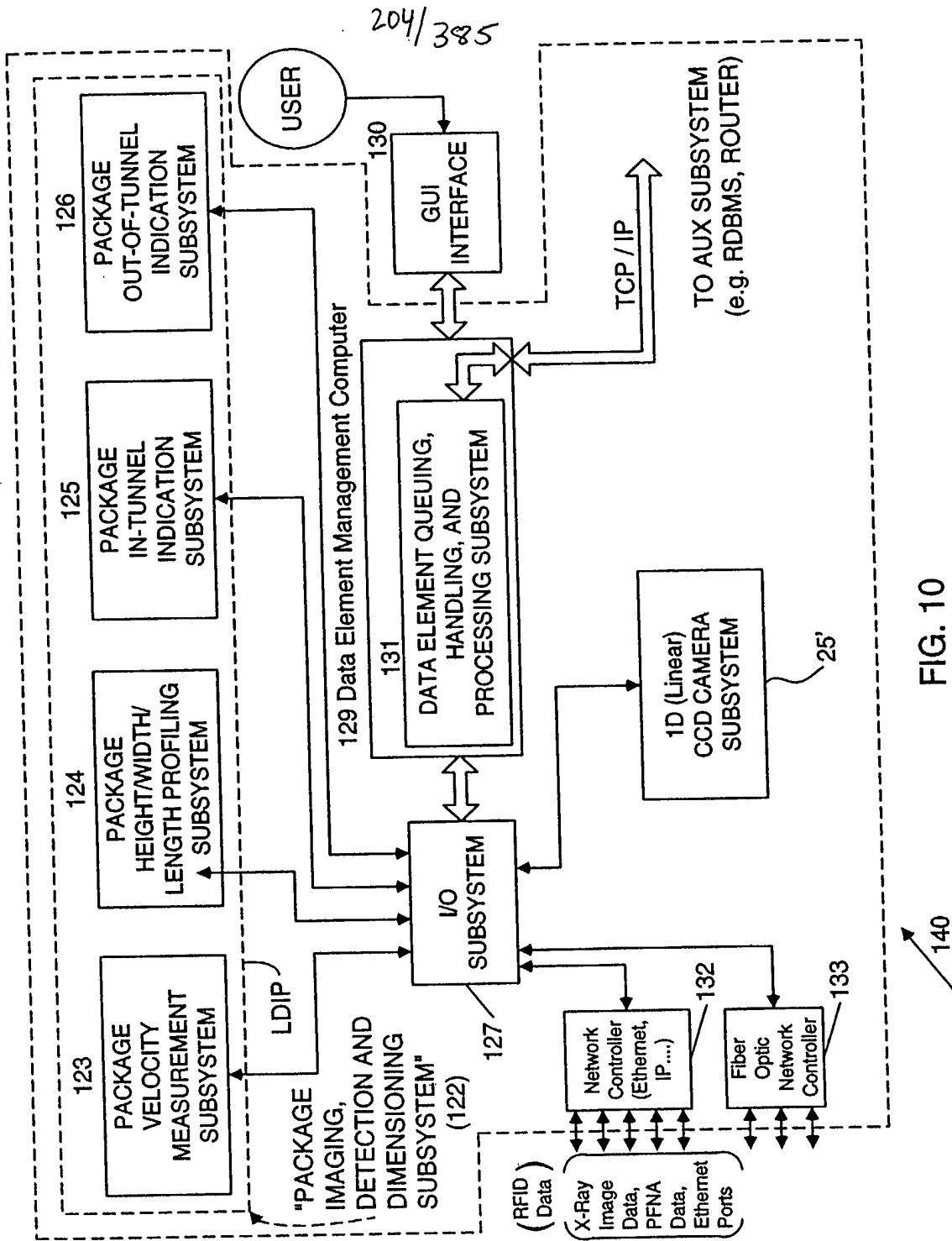


FIG. 9





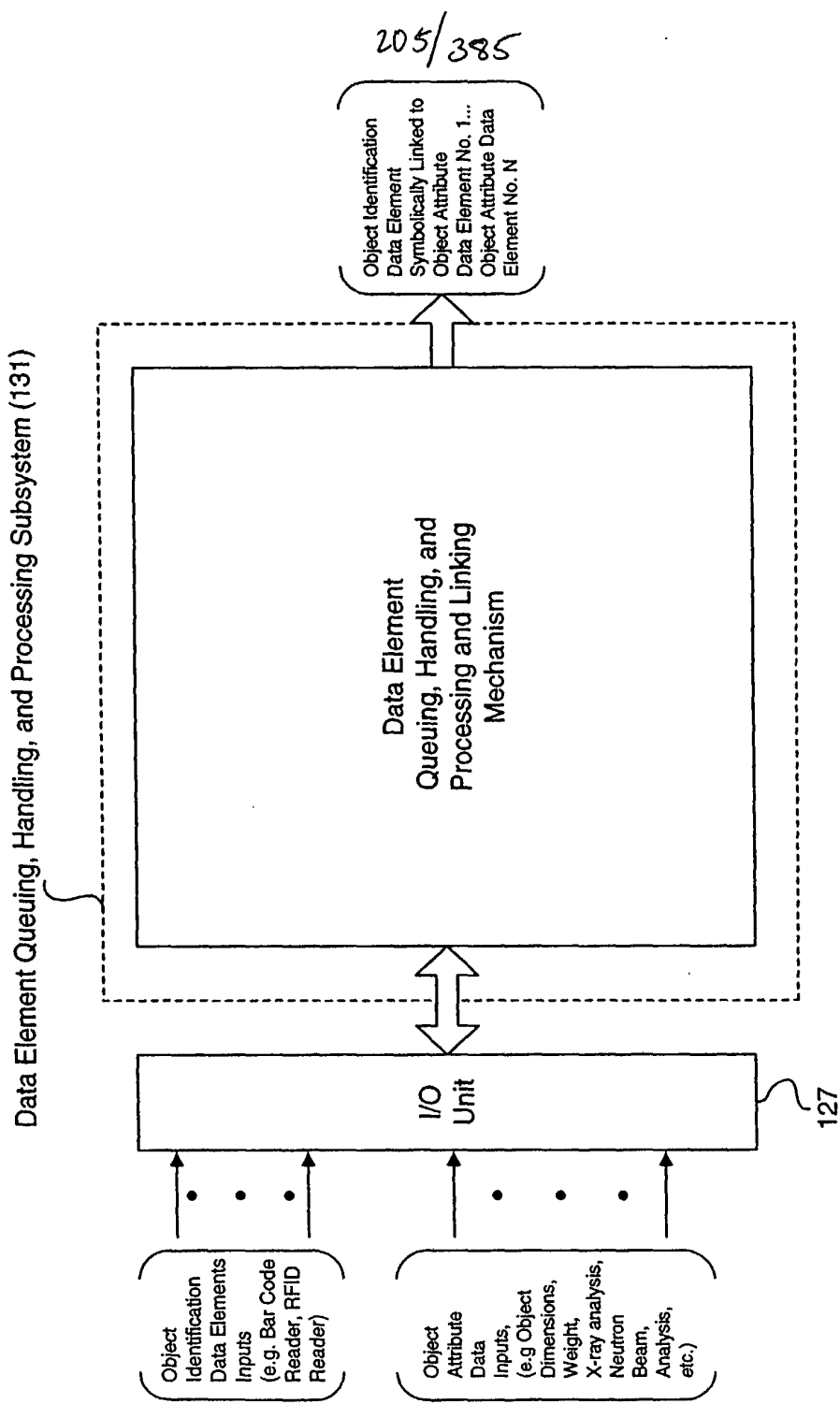


FIG. 10A

Primary Network  
and/ or System  
Functions:

A. Specification of Object  
Detection and  
Tracking Capability of  
System

B. Specification of Object  
Identification  
Capability of System

C. Specification of  
Object Attribute  
Acquisition Capability  
of System

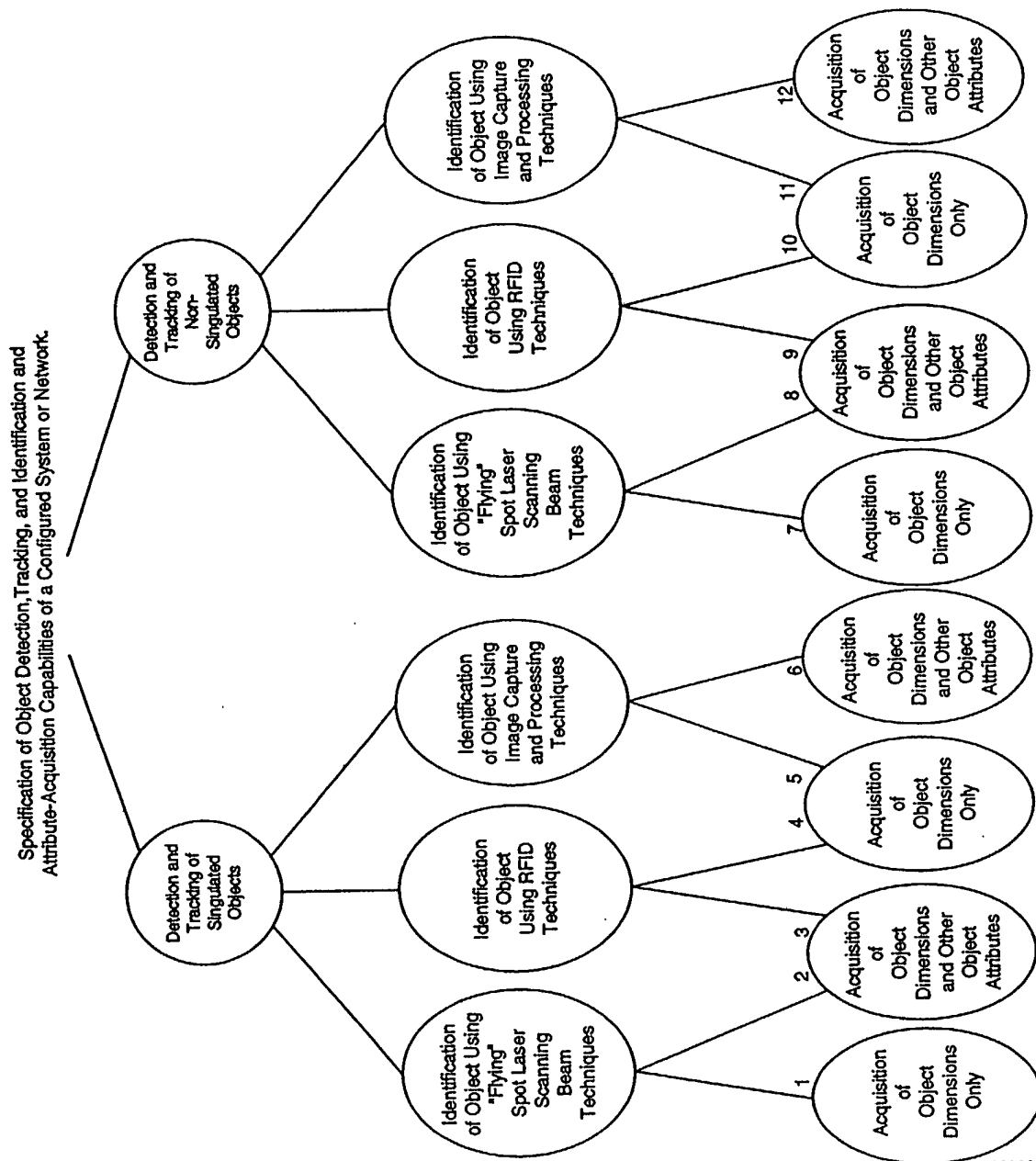


FIG. 10B

10004077, 002702

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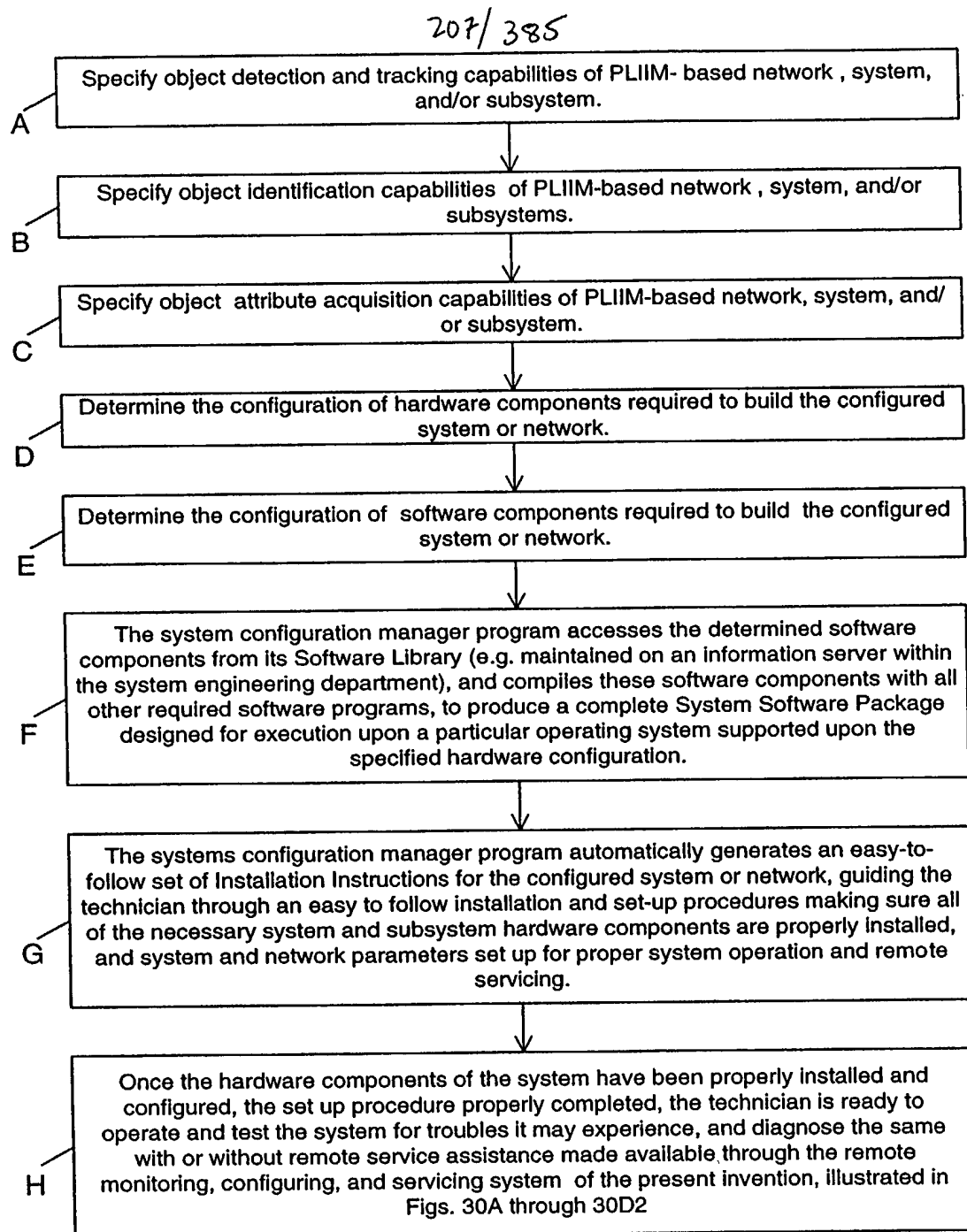


FIG. 10C

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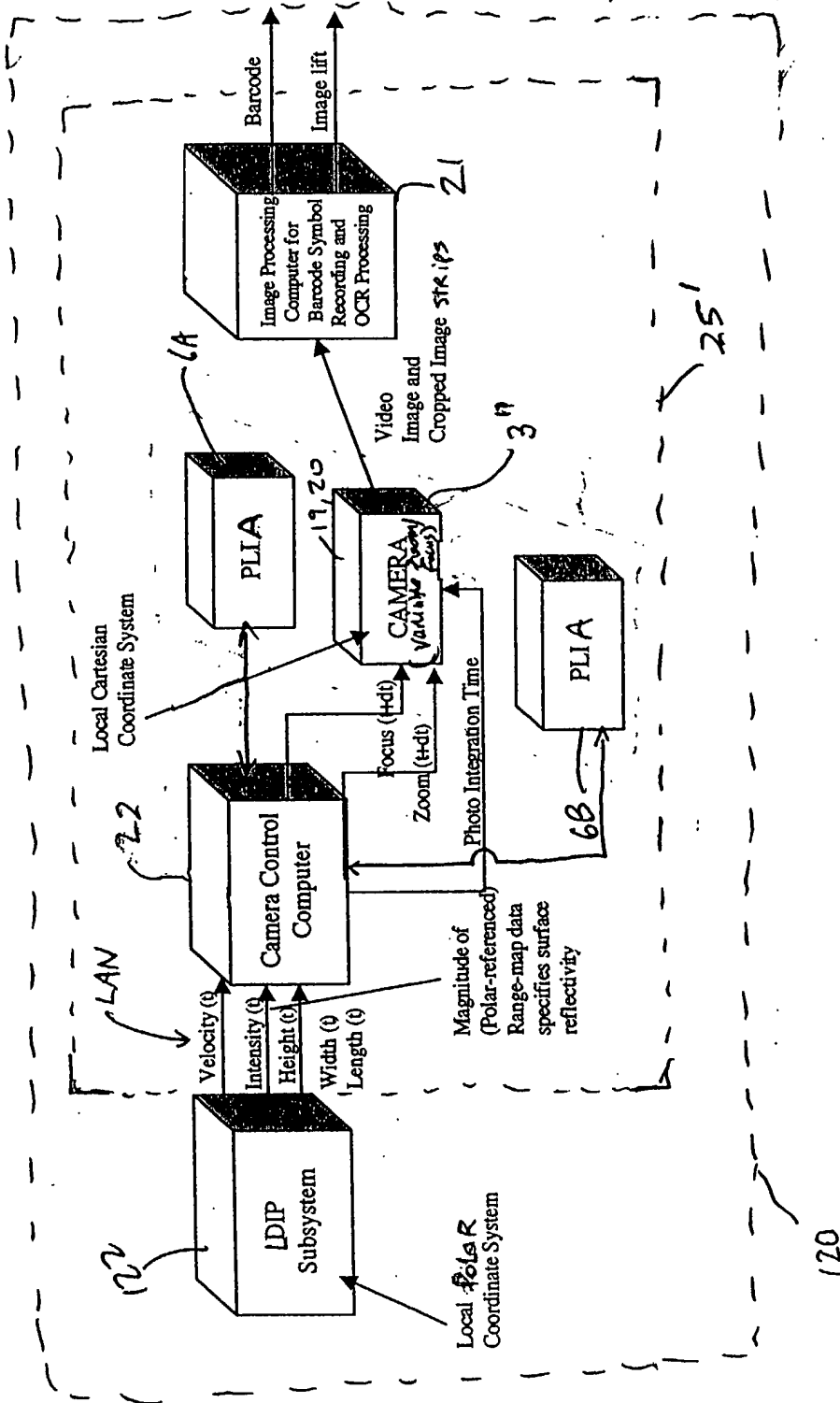


FIG. 11

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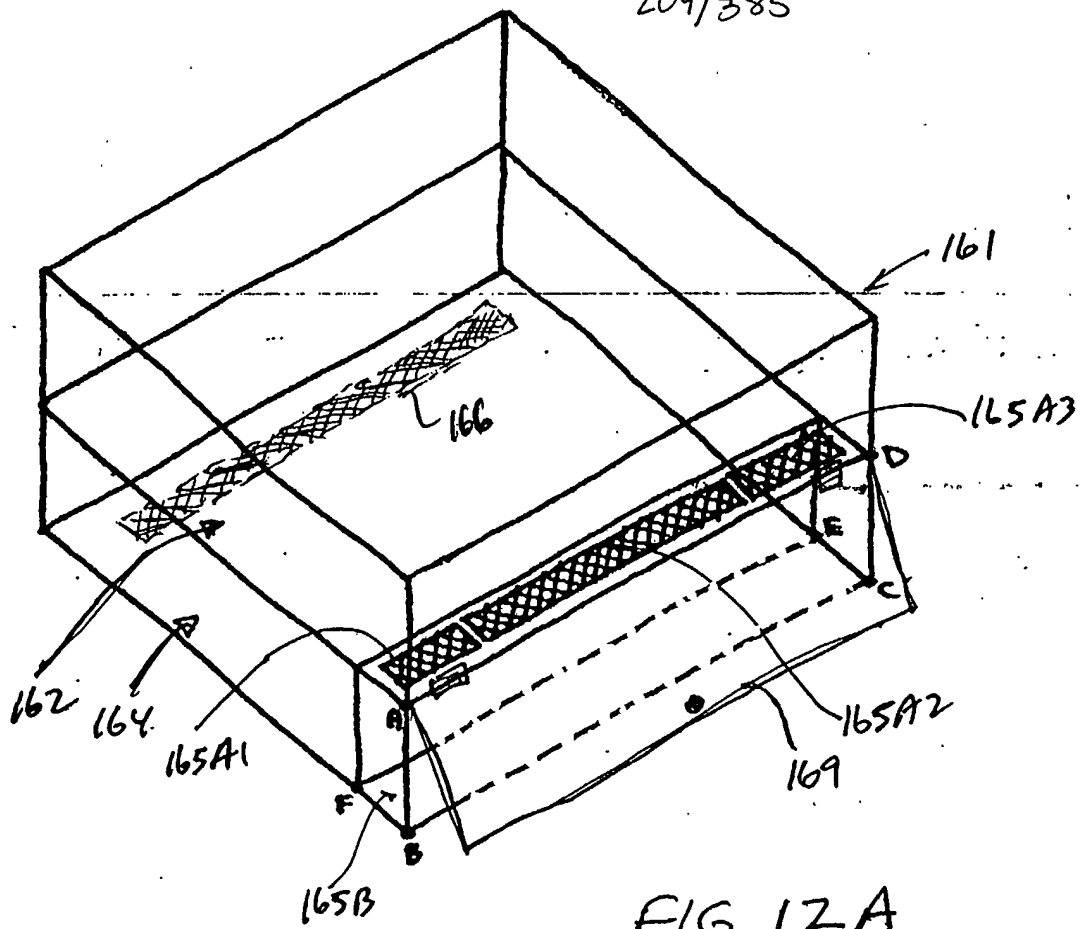


FIG. 12A



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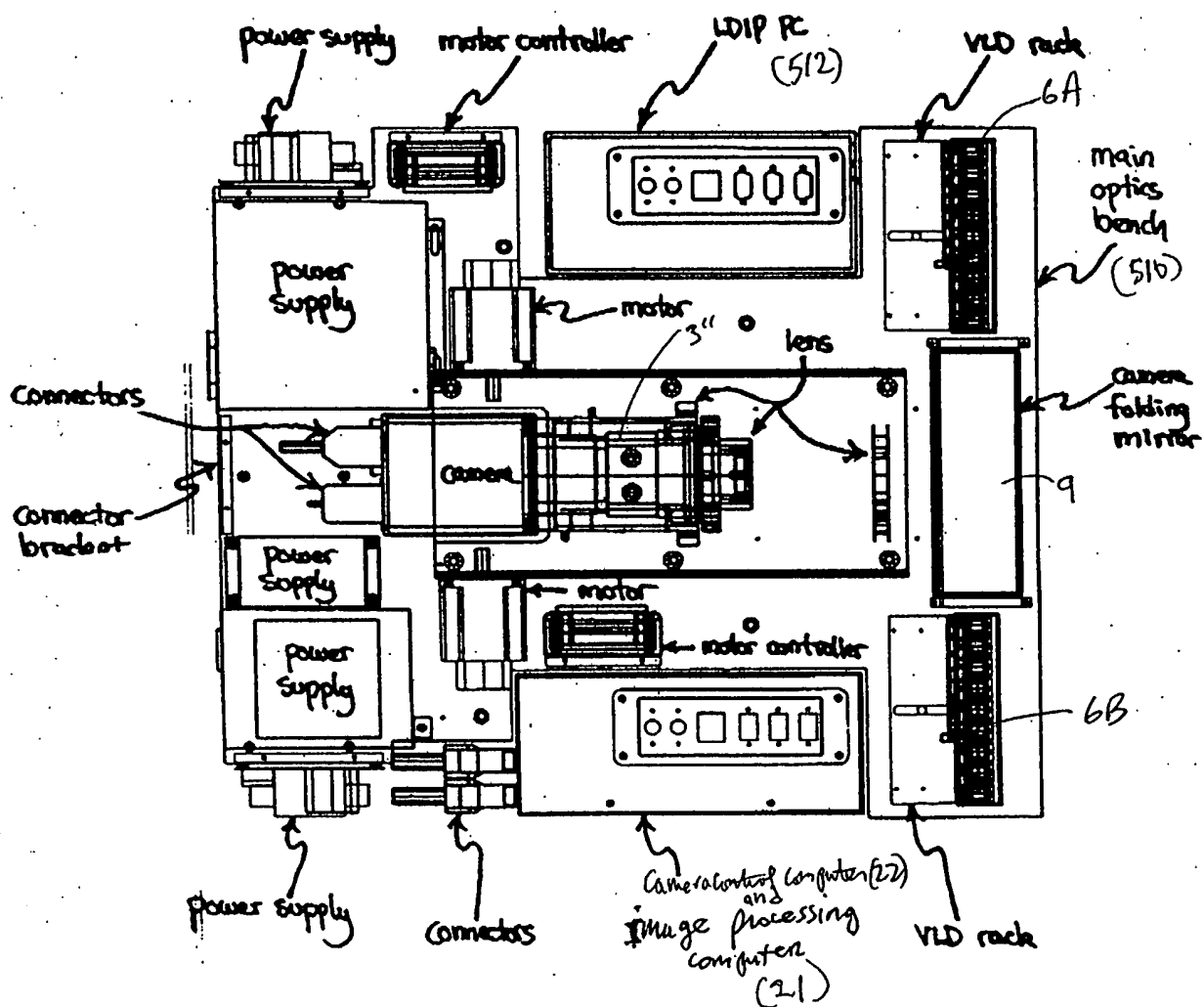


FIG. 12C

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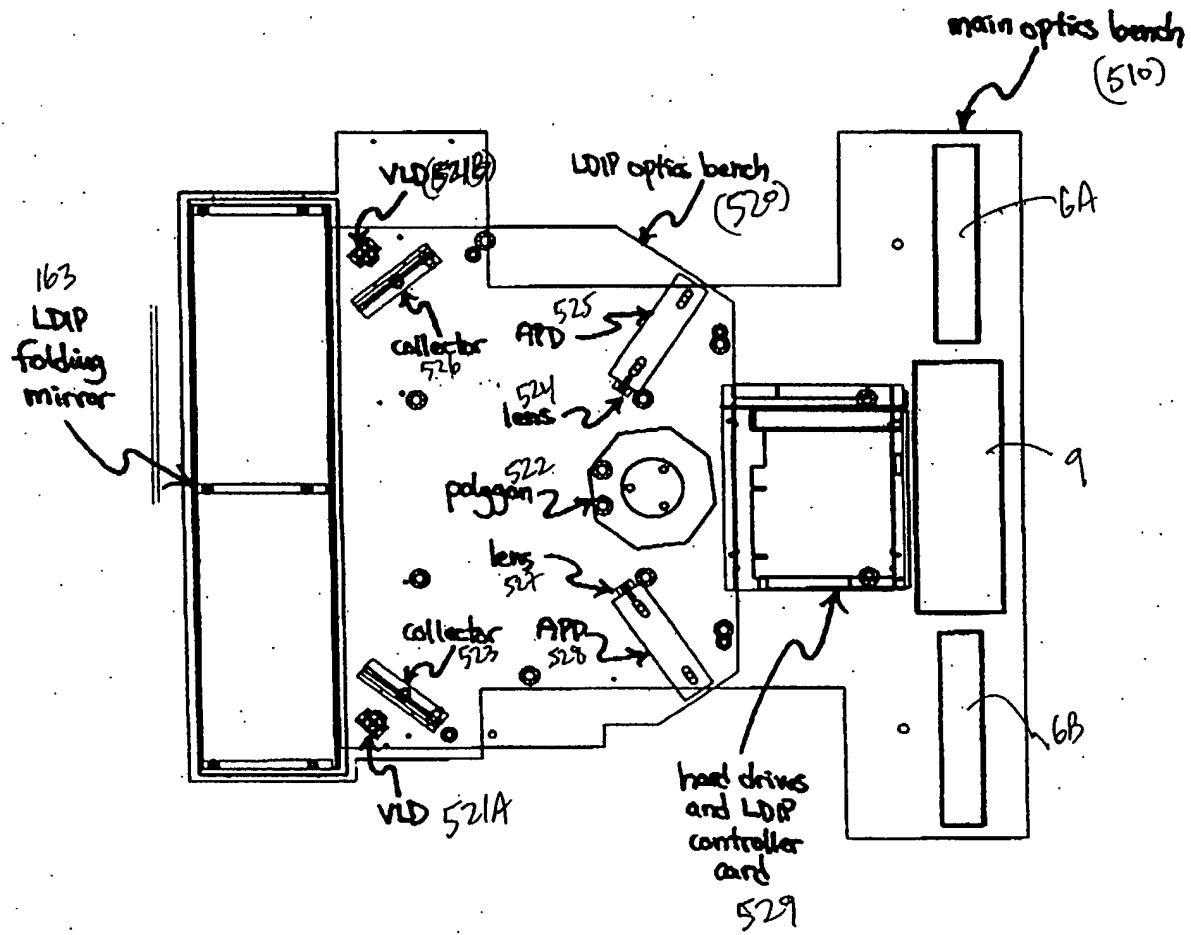
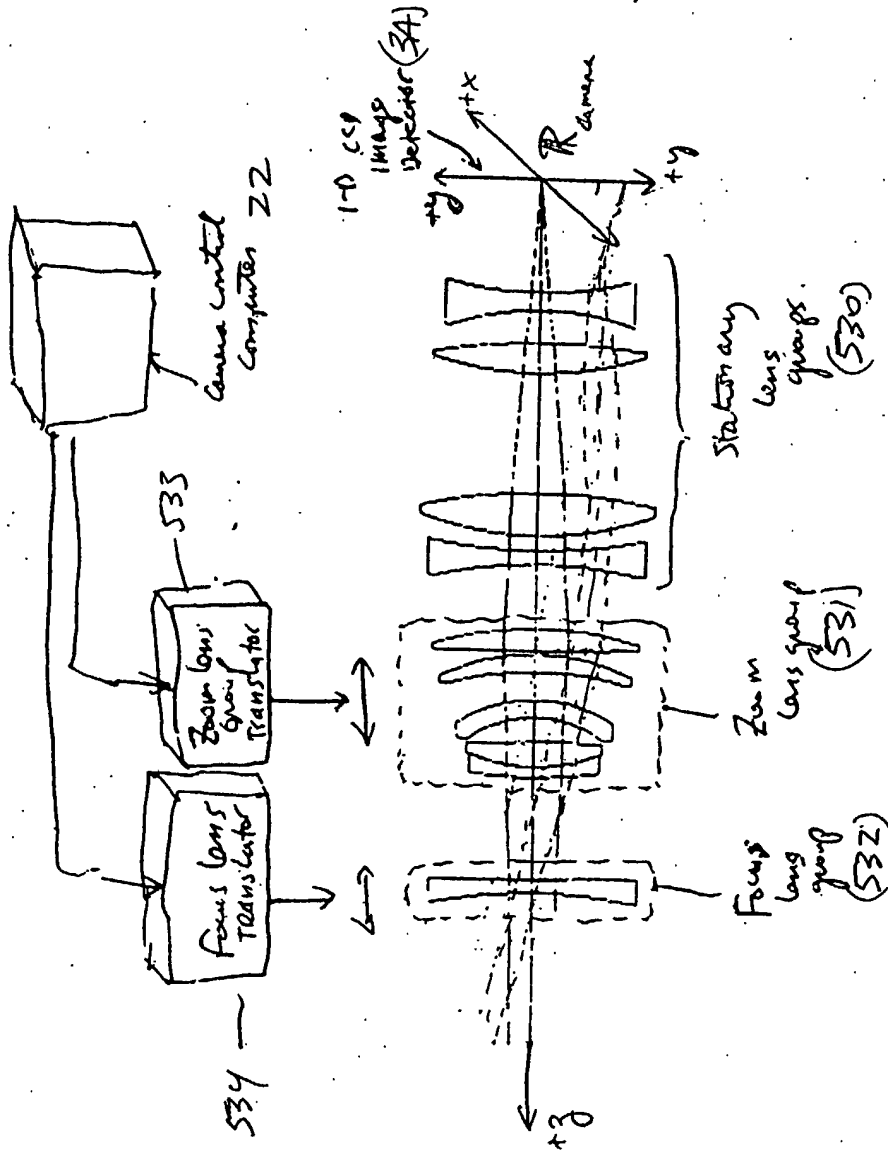


FIG. 12D



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(main optics)  
(Lens groups)

FIG. 12E

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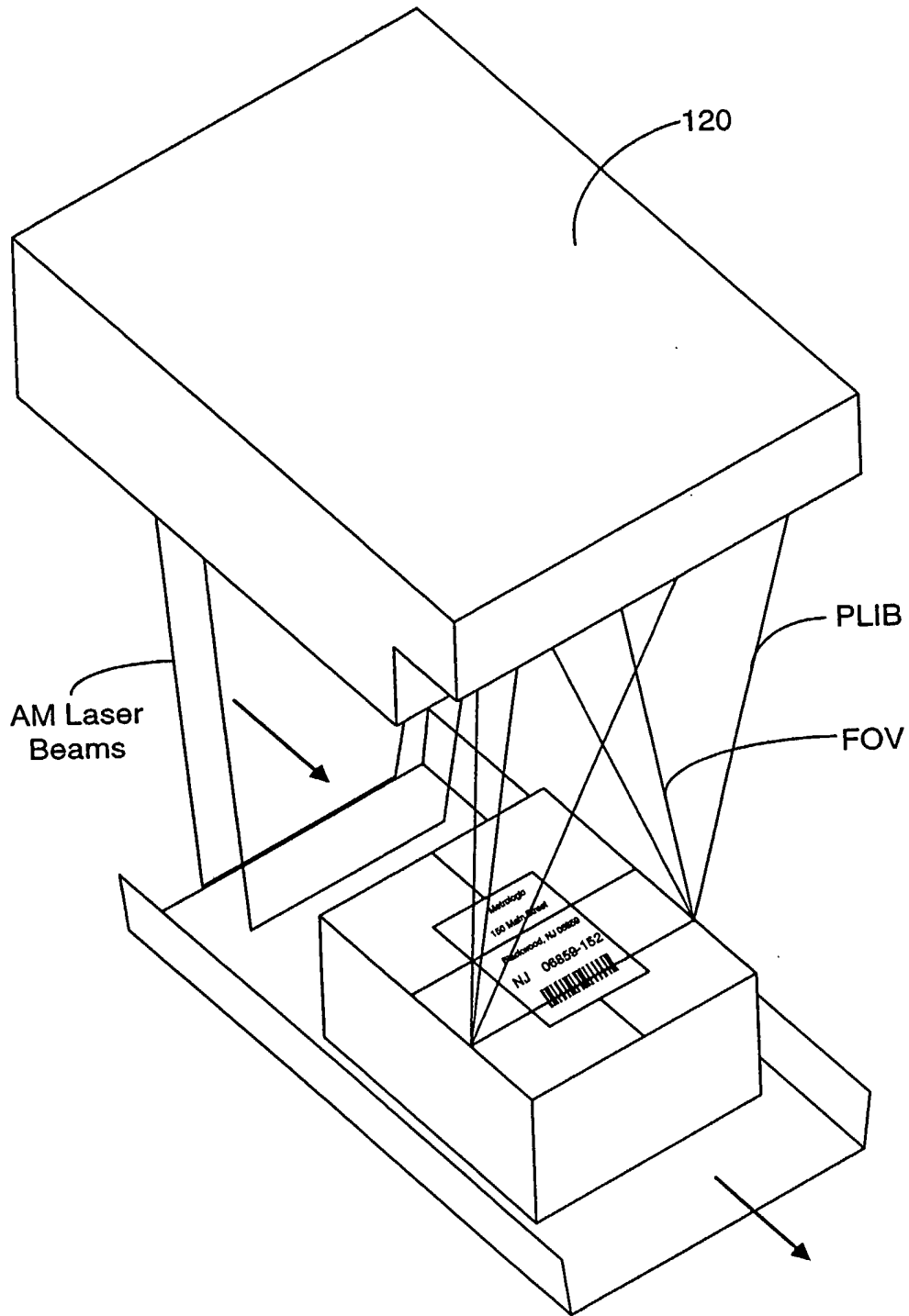


FIG. 13A

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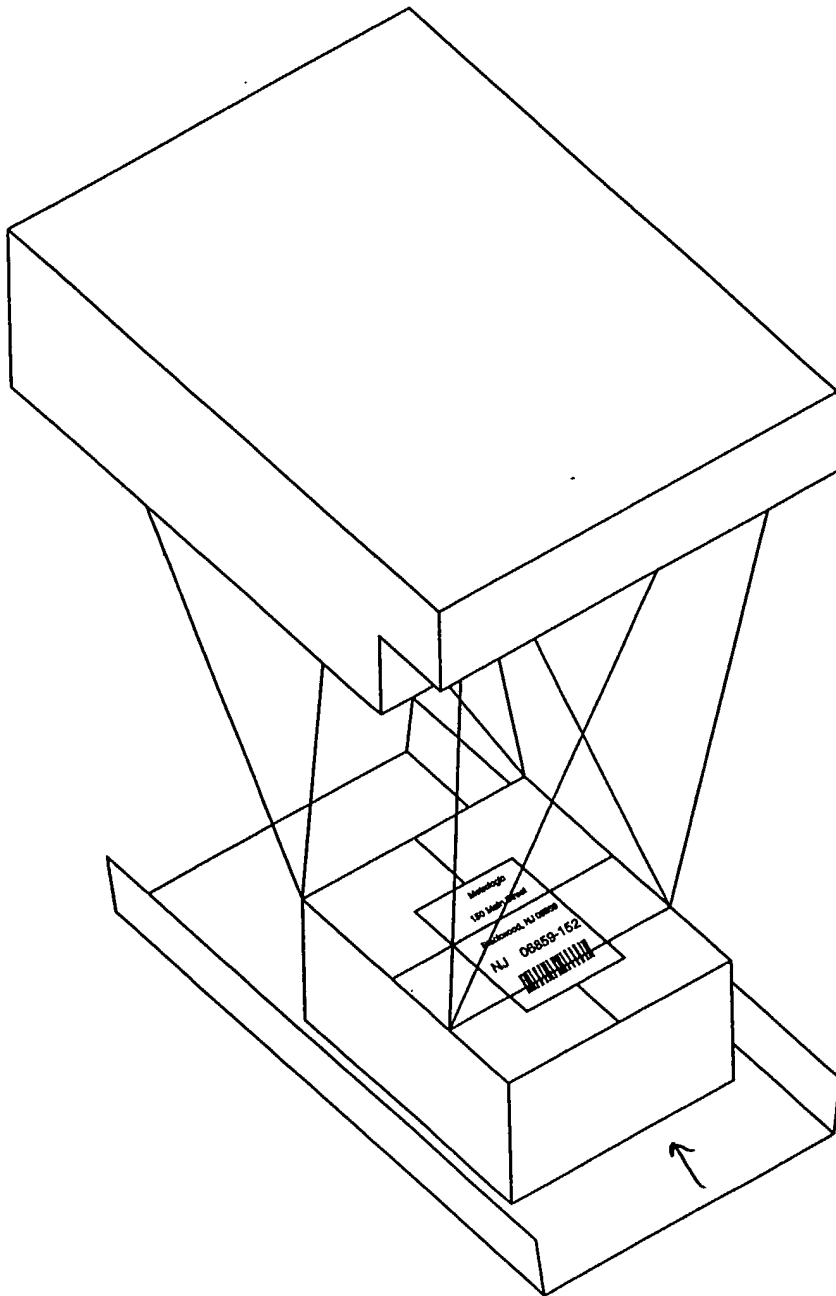


FIG. 13A

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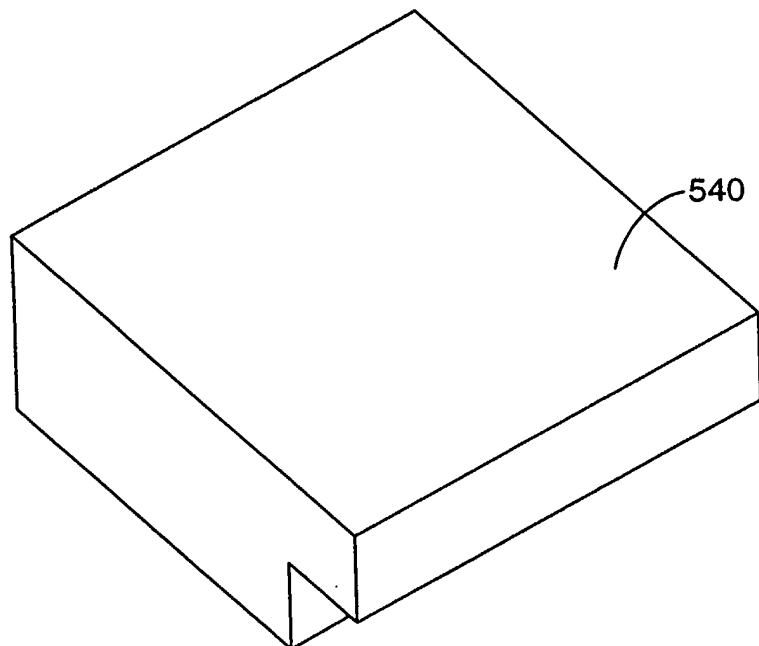


FIG. 13B

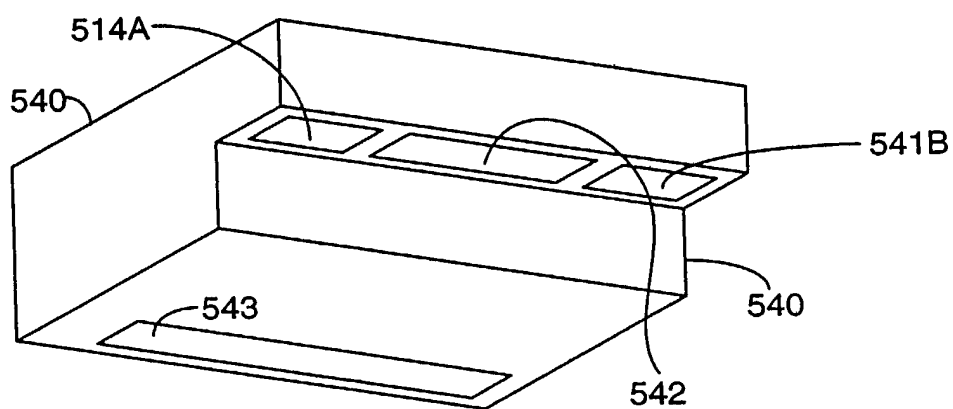


FIG. 13C

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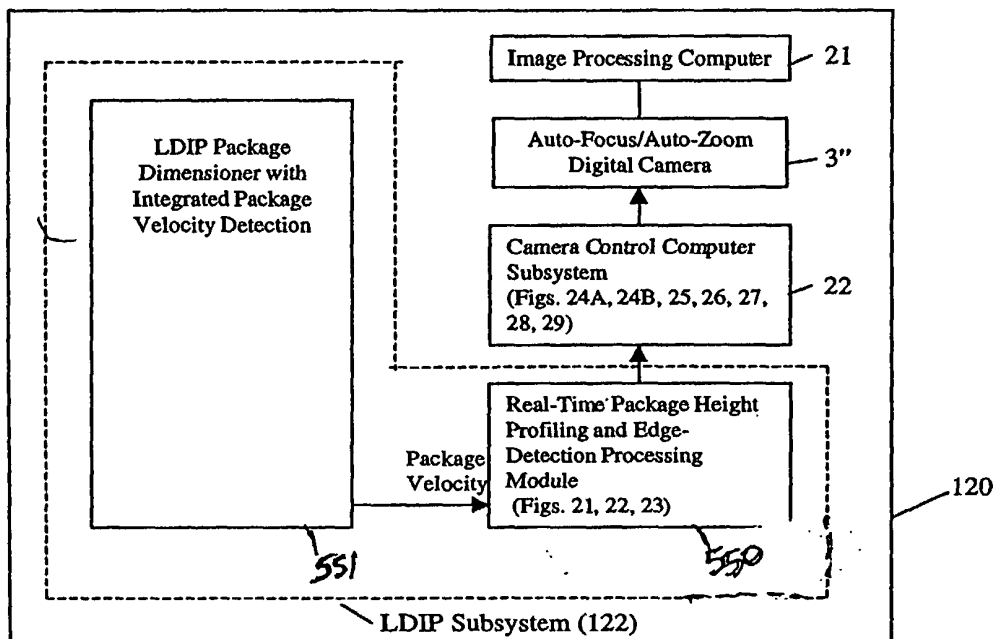
PLLIM-BASED PACKAGE IDENTIFICATION AND  
DIMENSIONING (PID) SYSTEM

FIG. 14

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# LDIP REAL-TIME PACKAGE HEIGHT PROFILE AND EDGE DETECTION METHOD

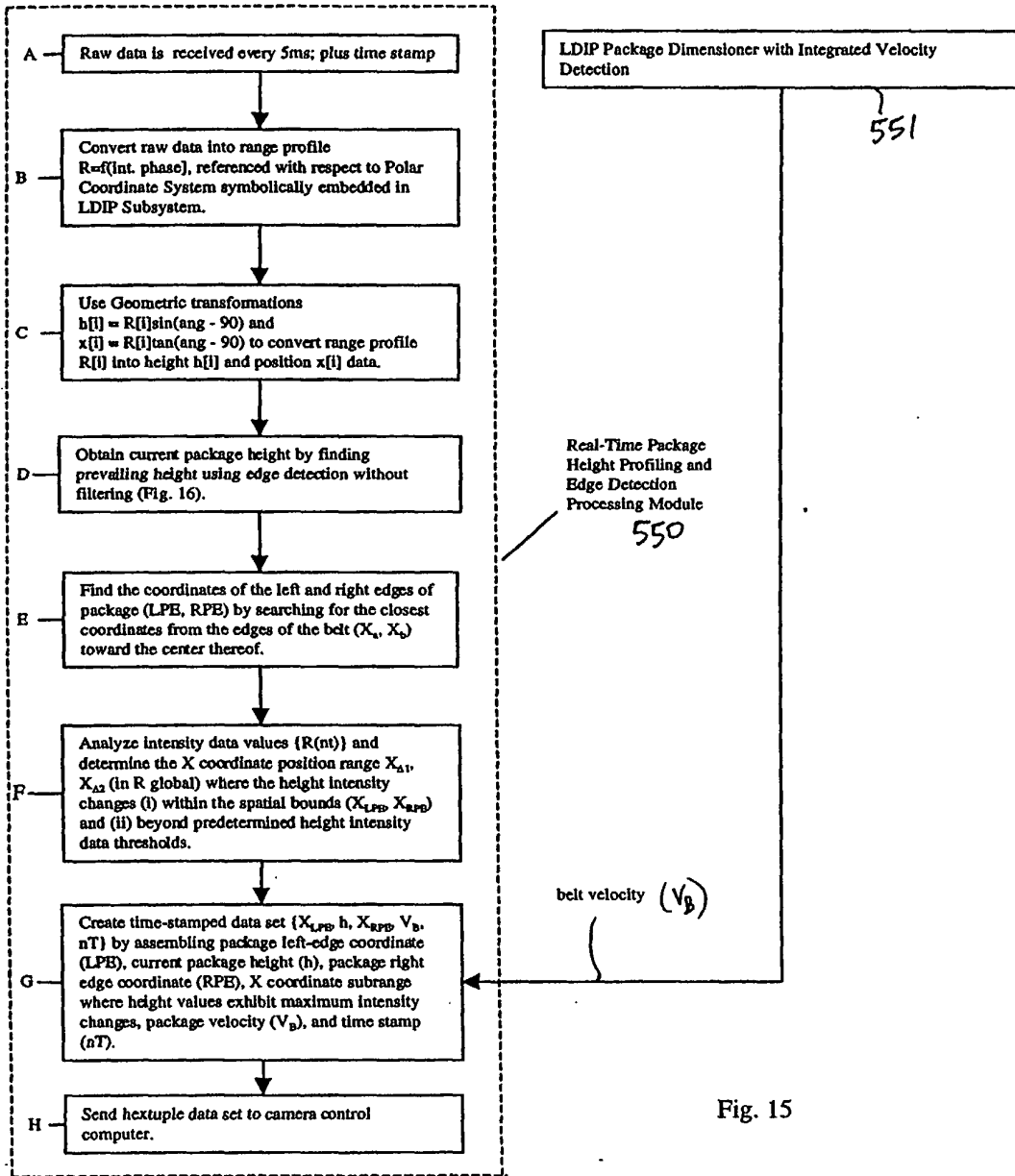


Fig. 15

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## LDIP Real Time Package Edge Detection

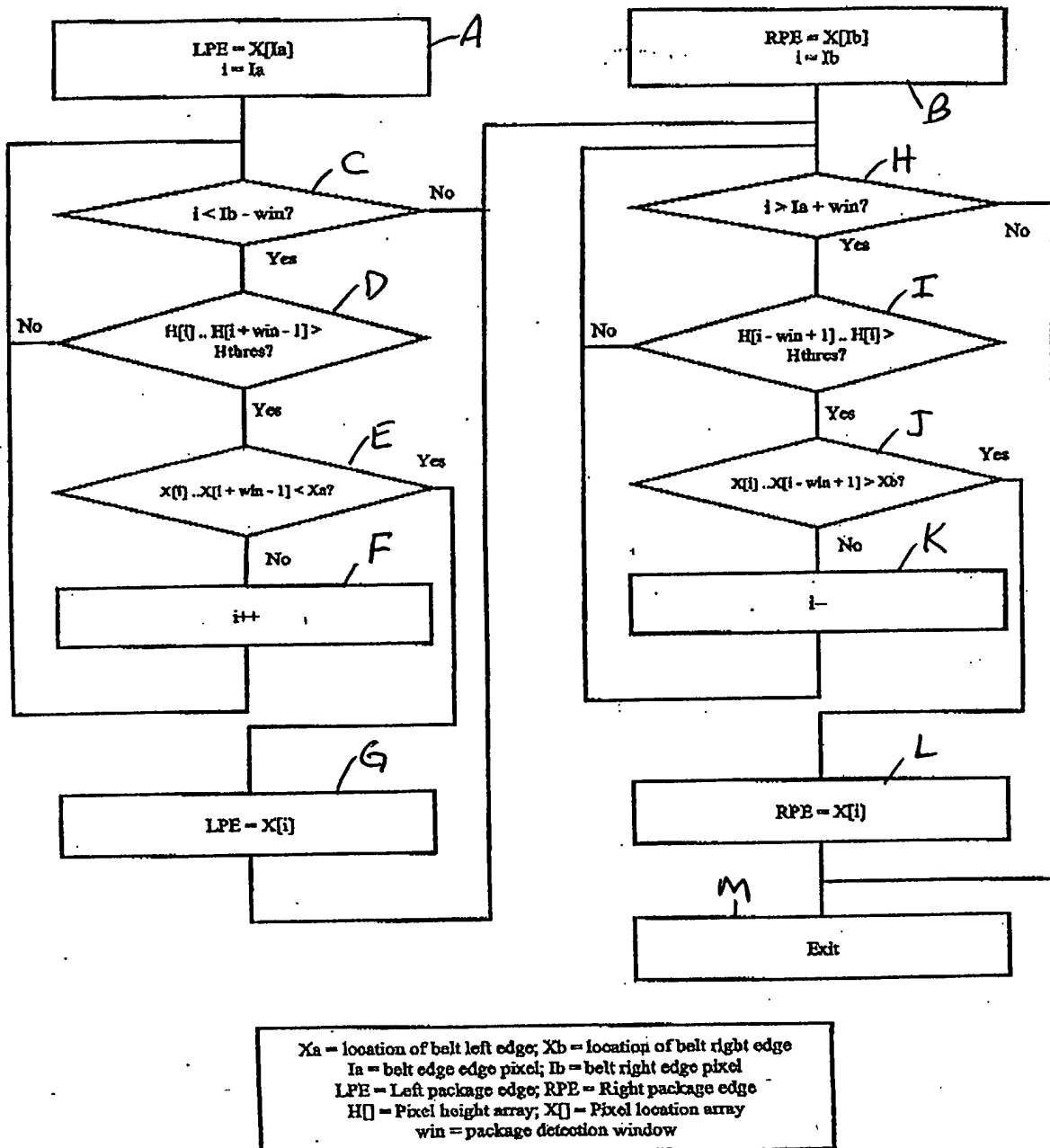


FIG. 16

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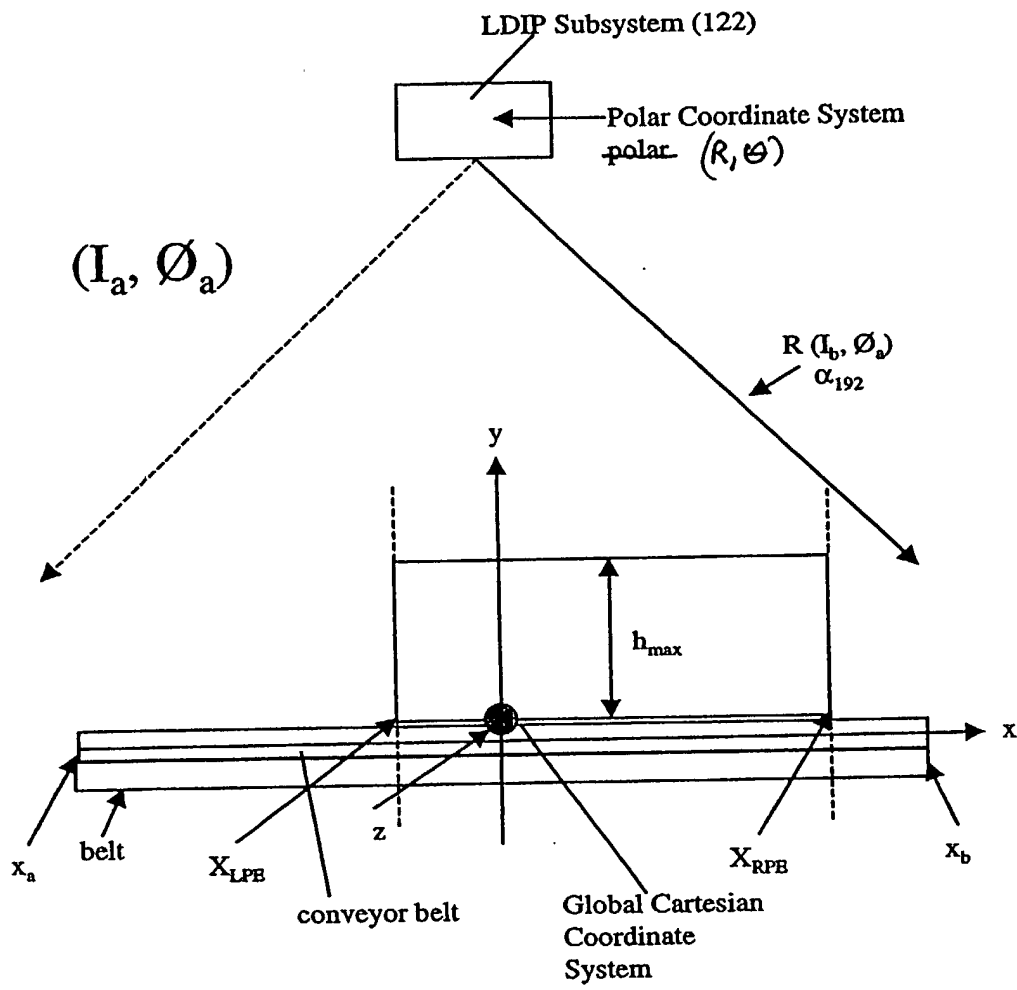


Fig. 17



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# INFORMATION MEASURED AT SCAN ANGLES BEFORE COORDINATE TRANSFORMS

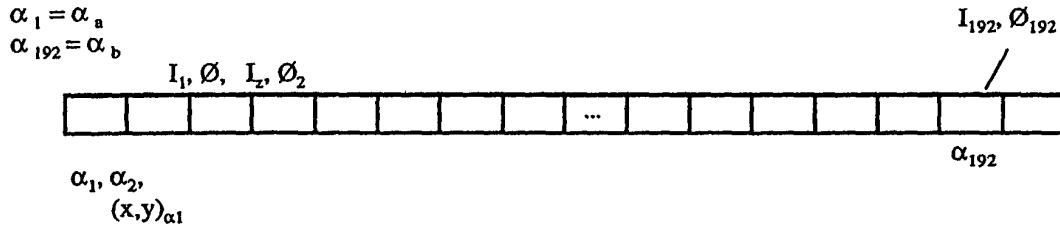


Fig. 17A

# RANGE AND POLAR ANGLE MEASURES TAKEN AT SCAN ANGLE $\alpha$ BEFORE COORDINATE TRANSFORMS

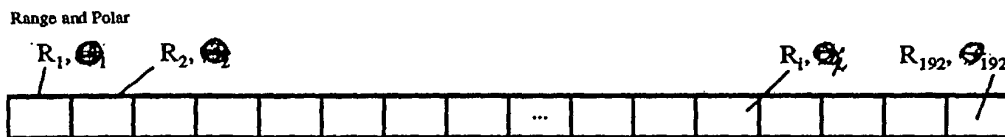


Fig. 17B

# MEASURED PACKAGE HEIGHT AND POSITION VALUES AFTER COORDINATE TRANSFORMS

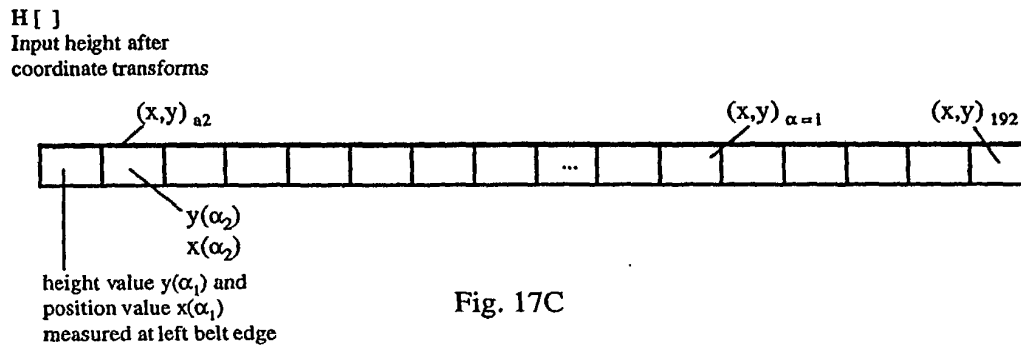


Fig. 17C

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CAMERA CONTROL PROCESS CARRIED OUT WITHIN THE CAMERA  
CONTROL SUBSYSTEM OF EACH OBJECT IDENTIFICATION AND  
ATTRIBUTE ACQUISITION SYSTEM OF PRESENT INVENTION

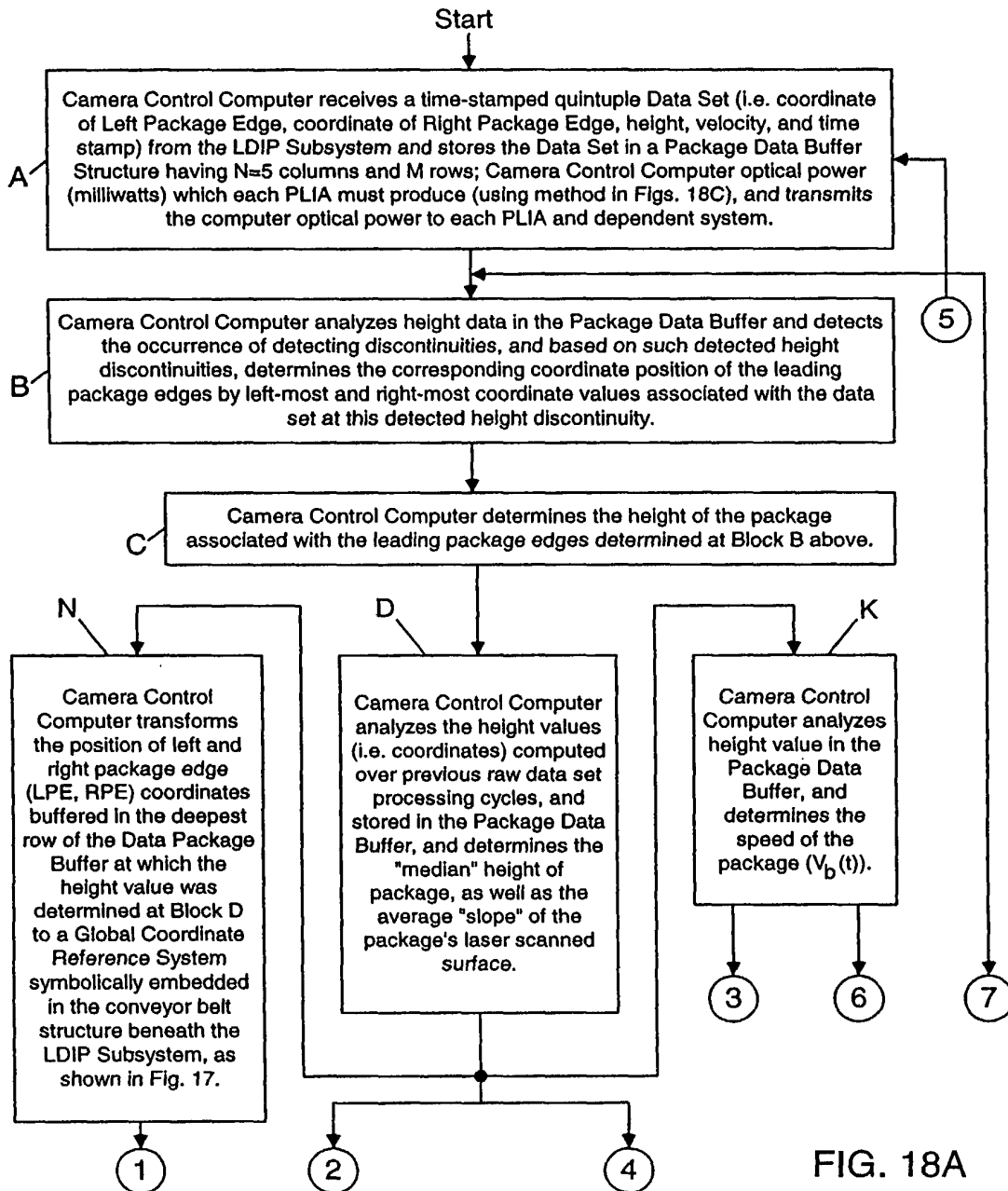


FIG. 18A

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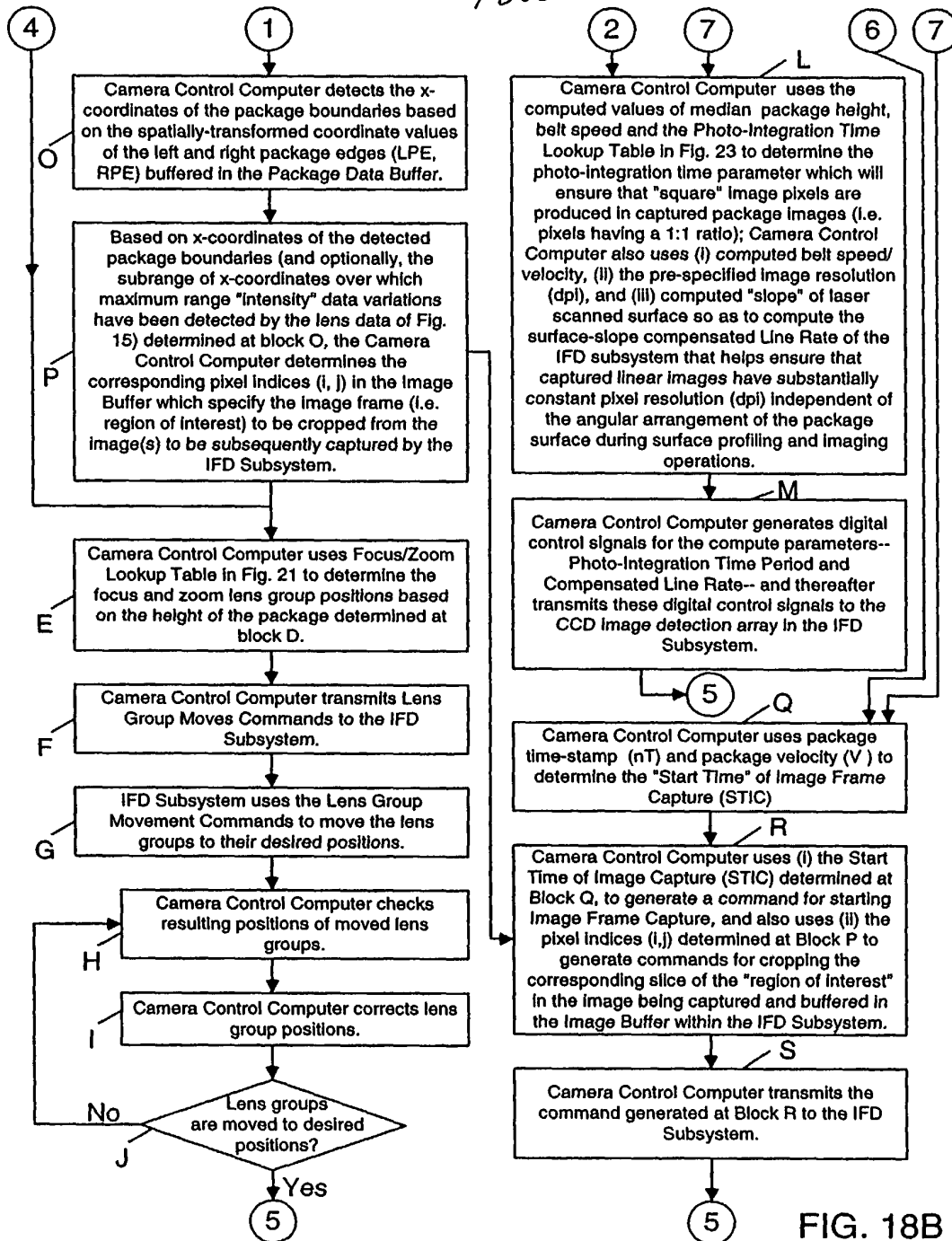


FIG. 18B

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METHOD OF COMPUTING OPTICAL OUTPUT POWER FROM CASE  
DIODES IN PLANAR LASER ILLUMINATION ARRAY (PLIA) FOR  
CONTROLLING CONSTANT WHITE LEVEL IN IMAGE PIXELS CAPTURED  
BY PLIIM-BASED LINEAR IMAGER

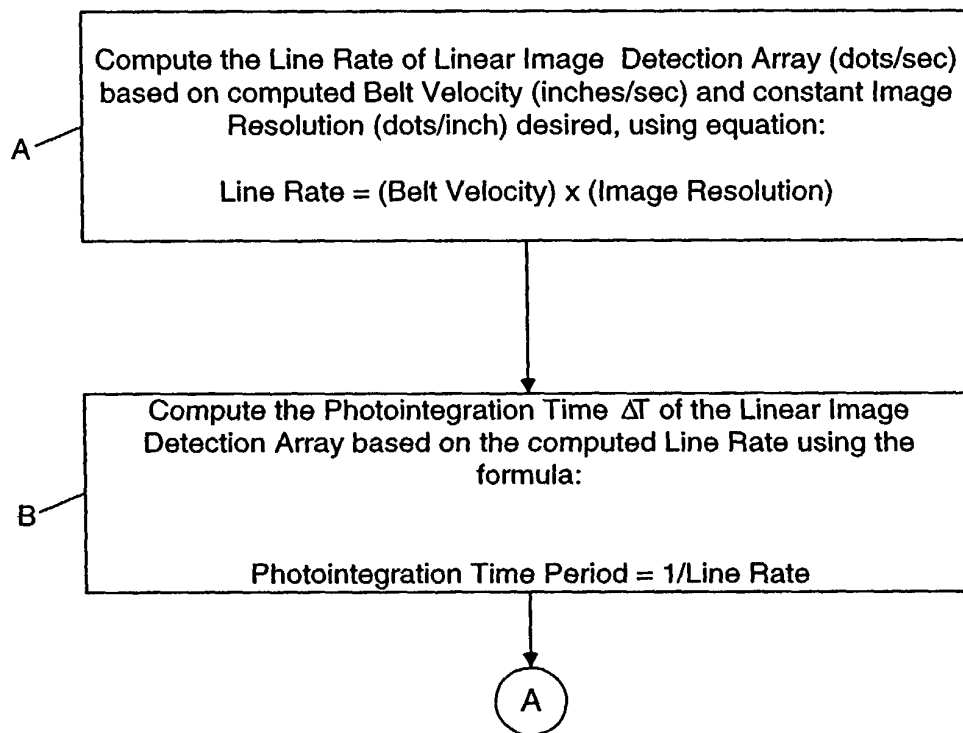


FIG. 18C1

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A



Compute the Optical Power (milliwatts) of each PLIA based on computed Photointegration Time Period ( $\Delta T$ ) using the following formula:

$$\text{Optical Power of VLD (milliwatts)} = \frac{\text{constant}}{\text{Photointegration Time Period } \Delta T}$$

FIG. 18C2

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METHOD OF COMPUTING COMPENSATED LINE RATE FOR CORRECTING  
VIEWING-ANGLE DISTORTION OCCURING IN IMAGES OF OBJECT  
SURFACES CAPTURED AS OBJECT SURFACES MOVE PAST PLIM-  
BASED LINEAR IMAGER AT NON-ZERO SKEWED ANGLE

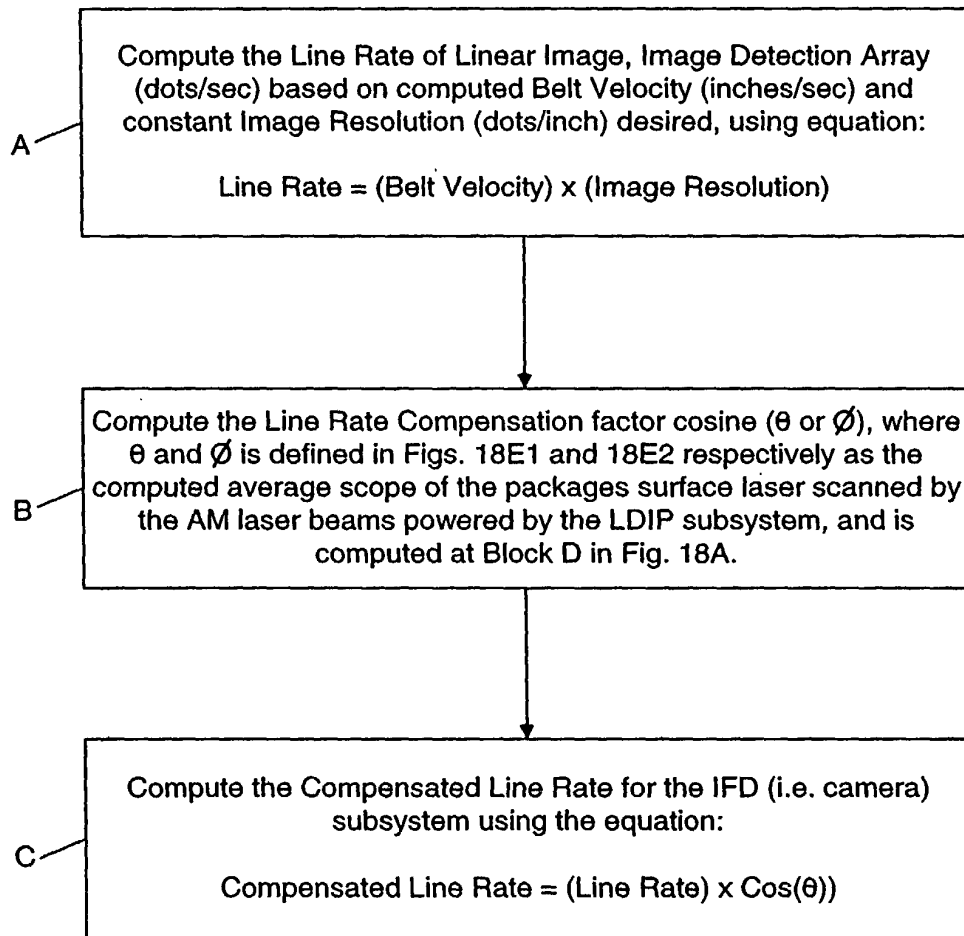


FIG. 18D

CASE 1:  
Top Down Imaging

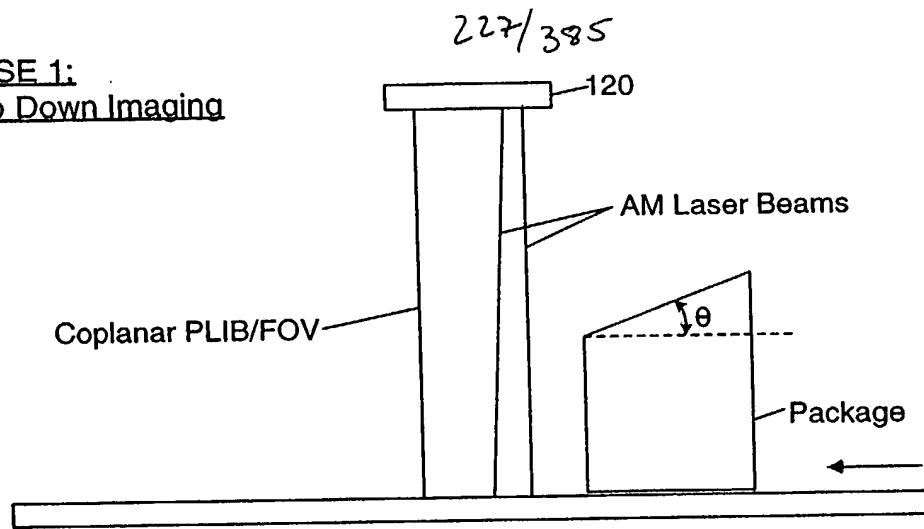


FIG. 18E1

CASE 2:  
Side Imaging

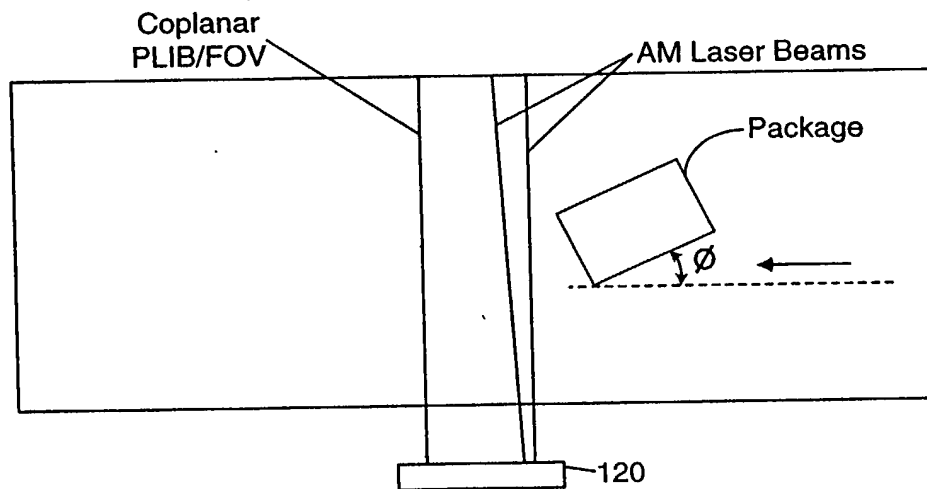


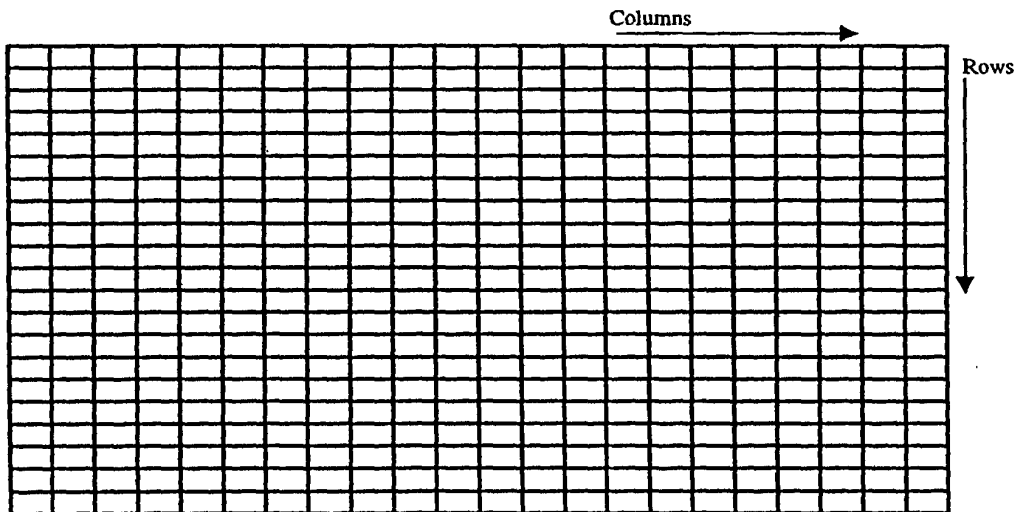
FIG. 18E2

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X coordinate subrange where  
maximum range "intensity"  
variations have been detected

Left Package Edge (LDE)	Package Height (h)	Right Package Edge (RPE)	Package Velocity	Time-stamp (nT)	
					Row 1
					Row 2
					Row 3
					Row 4
					Row 5
					Row M
Package Data Buffer (FIFO)					

Fig. 19



Camera Pixel Data Buffer  
pixel indices (i,j)

Fig. 20



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Zoom and Focus Lens Group Position  
Looking Table

Distance from Camera H (mm)	Zoom group distance (mm) Y (Zoom)	Focus group distance (mm) Y (Focus)
1000	21.57489228	2.47E-05
1100	19.38089696	10.99009783
1200	17.10673434	20.65783177
1300	14.77137314	29.10917002
1400	12.39153565	36.47312595
1500	9.979114358	42.87845436
1600	7.540639114	48.44003358
1700	5.078794775	53.25495831
1800	2.595989366	57.40834303
1900	0.099972739	60.98883615

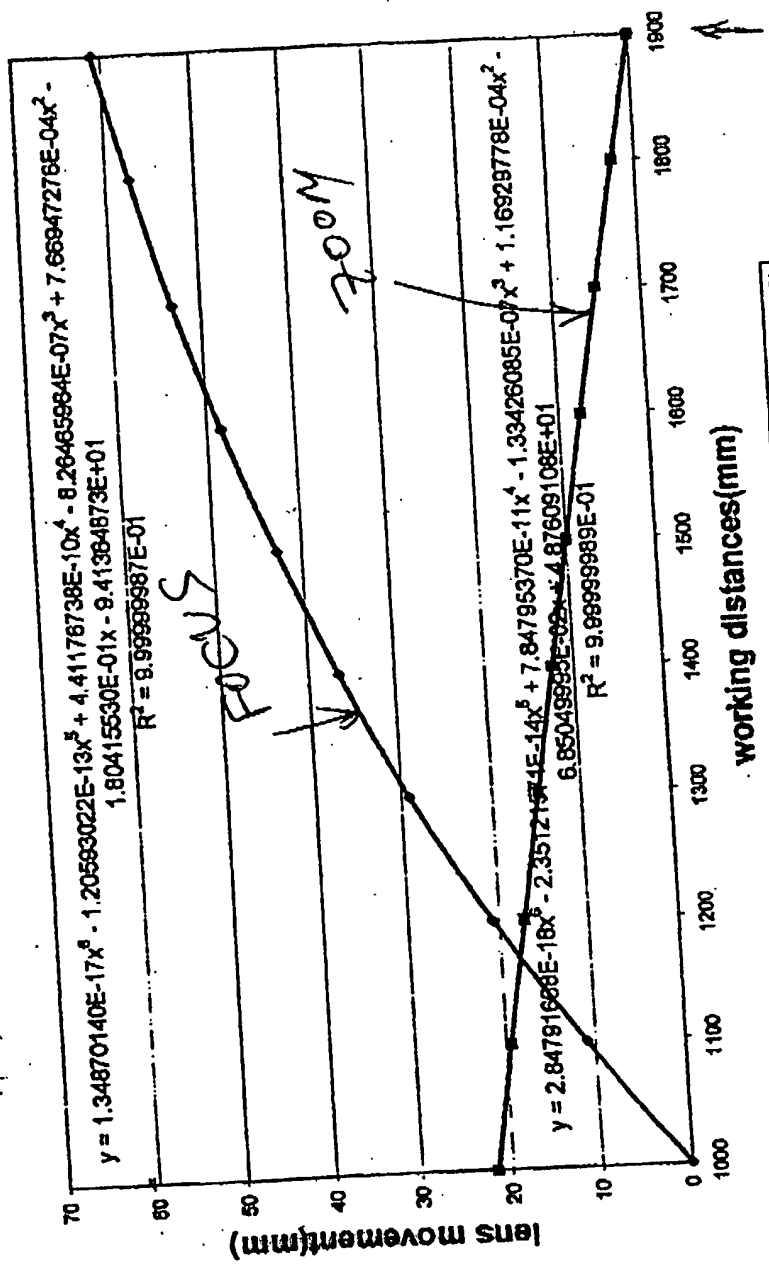
(use  
interpolation  
techniques  
for walking  
distances  
between listed  
points in  
table)

FIG. 21.

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\* Note: On feed distance & zoom (left hand graph) in camera lens are coupled (inter-dependent) in camera has a fixed aperture F5.6 this command on belmont.

### Focus and Zoom lens movement vs. working distances



zoom 1 zoom 2 Poly. (zoom 1) Poly. (zoom 2)

(inches) 11 30 above conveyor belt  
← package height above conveyor  
conveyor-belt surface

FIG. 22A

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Photo-Integration Time Look-Up Table

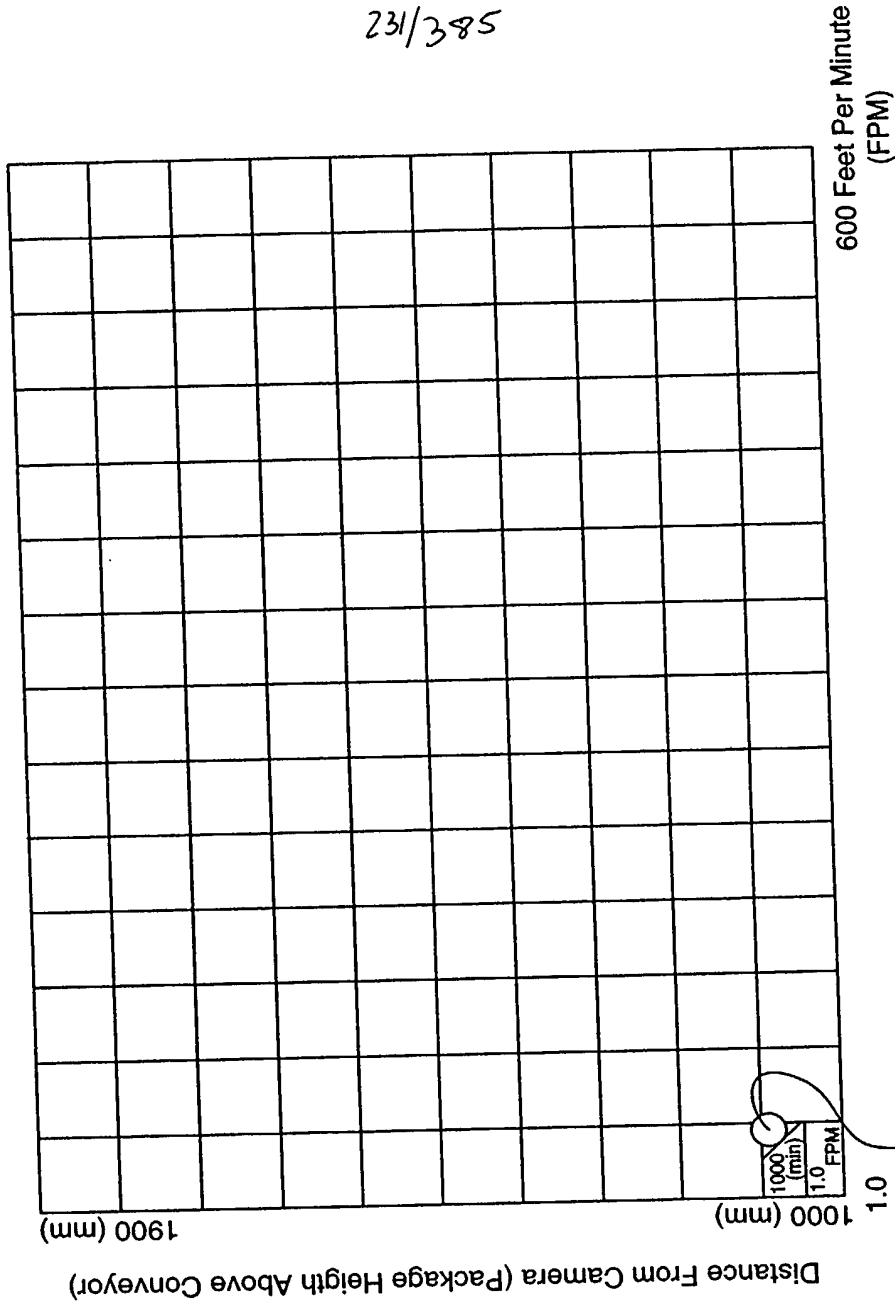


Photo-Integration Time Value  
That Ensures Square Image  
Pixels (1:1 aspect ratio)

FIG. 22B

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3D Surface Profile And High Resolution  
Linear Image Data Capture  
At PLIIM-Based Profiling  
And Imaging System

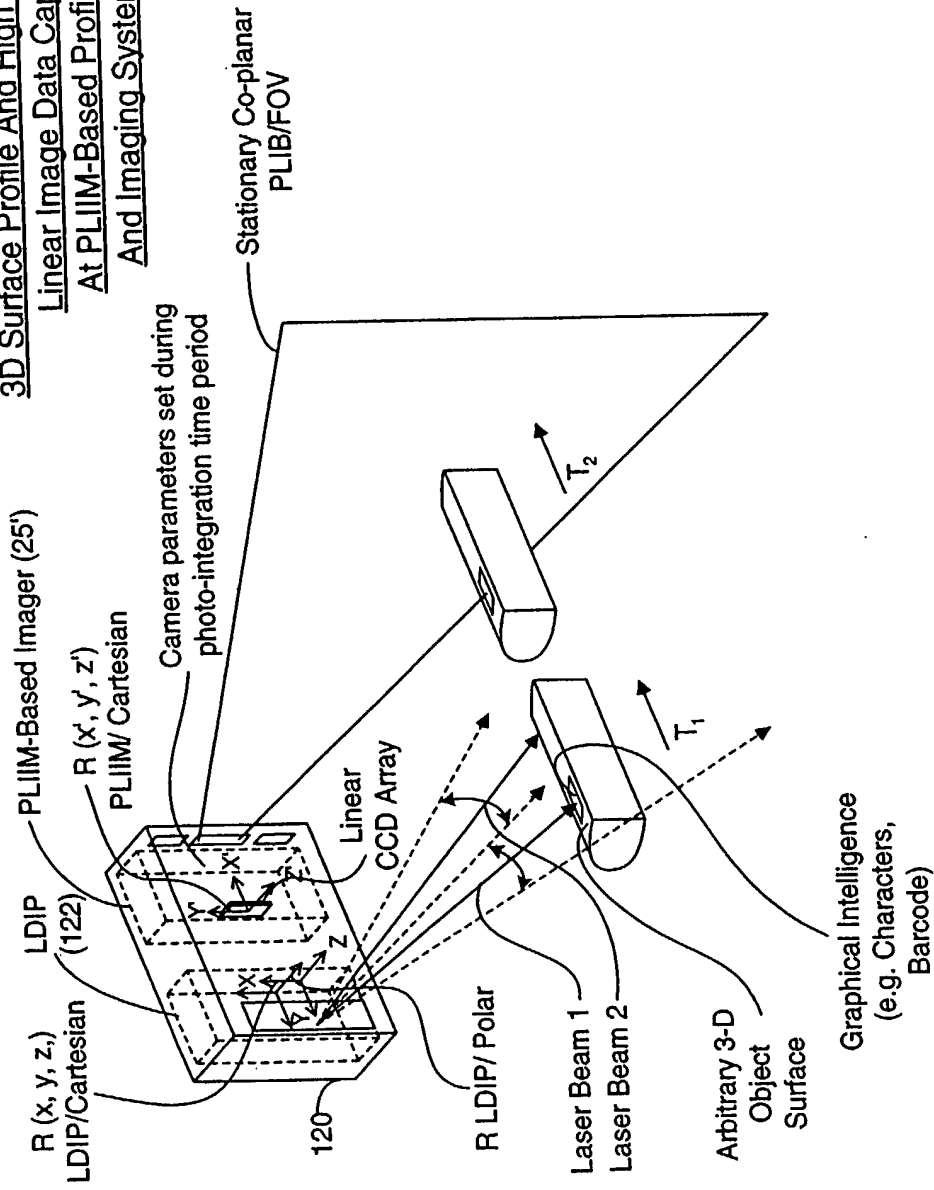


FIG. 23A

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Geometrical Modelling Of Arbitrary 3-D Object Surface  
At Image Processing Computer

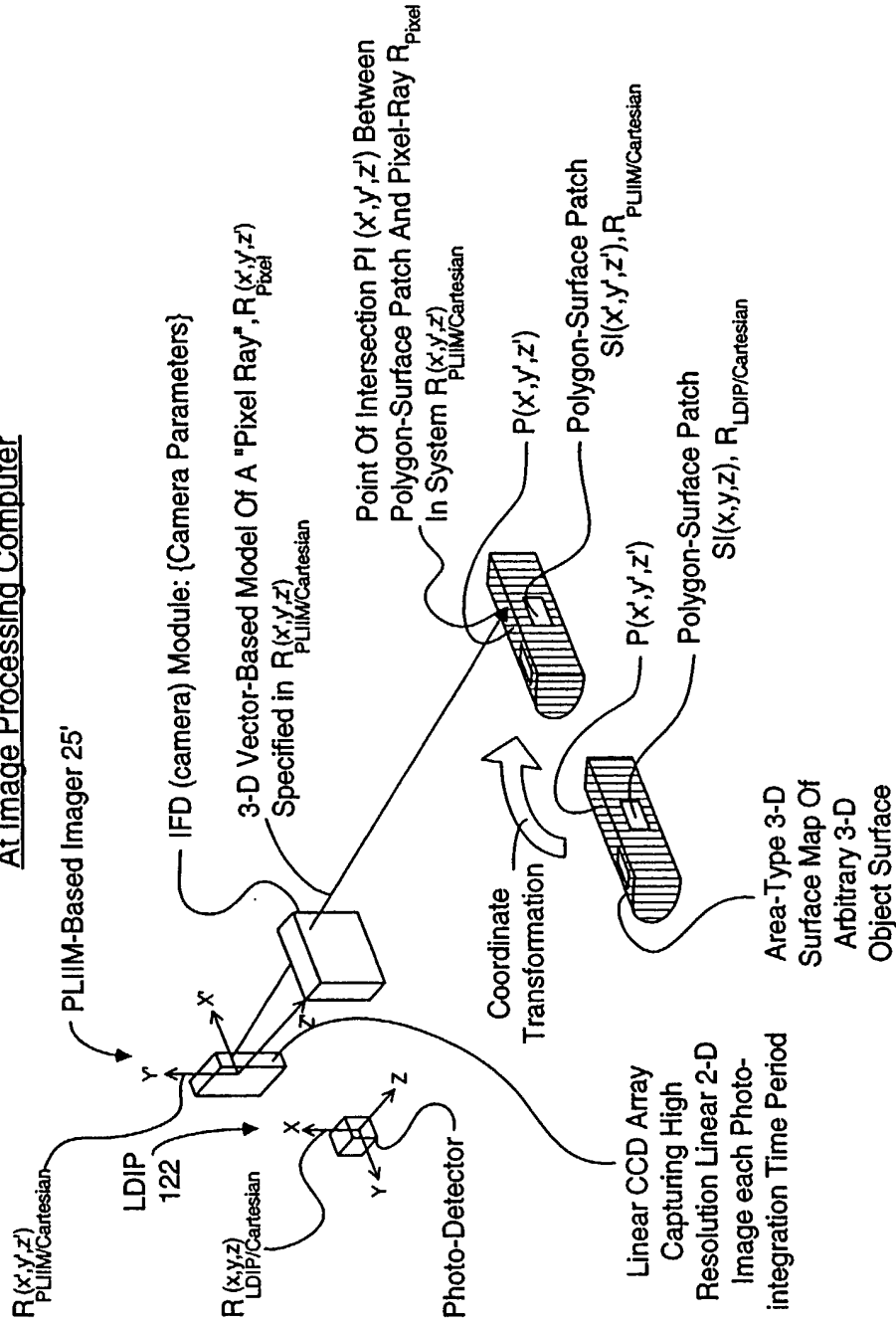


FIG. 23B

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METHOD OF AND APPARATUS FOR PERFORMING AUTOMATIC  
RECOGNITION OF GRAPHICAL INTELLIGENCE CONTAINED IN 2-D  
IMAGES CAPTURED FROM ARBITRARY 3-D OBJECT SURFACES

STEP 1: At the unitary PLIIM-based object imaging and profiling system, use the laser doppler imaging and profiling (LDIP) subsystem employed therein to (i) consecutively capture a series of linear 3-D surface profile maps on a targeted arbitrary (e.g. non-planar or planar) 3-D object surface bearing forms of graphical intelligence and (ii) measure the velocity of the arbitrary 3-D object surface, wherein the polar coordinates of each point in the captured linear 3-D surface profile map are specified in a local polar coordinate system  $R_{LDIP/polar}$ , symbolically embedded within the LDIP subsystem.

A

STEP 2: At the unitary PLIIM-based object imaging and profiling system, use coordinate transforms to automatically convert the polar coordinates of each point  $p(\alpha, R)$  in the captured linear 3-D surface profile map into x,y, z Cartesian coordinates specified as  $p(x,y,z)$  in a local Cartesian coordinate system  $R_{LDIP/Cartesian}$ , symbolically embedded within the LDIP subsystem.

B

STEP 3: At the unitary PLIIM-based object imaging and profiling system, use the PLIIM-based imager employed therein to consecutively capture high-resolution linear 2-D images of the arbitrary 3-D object surface bearing forms of graphical intelligence (e.g. symbol character strings), wherein (i) the  $x', y'$  coordinates of each pixel in each said captured high-resolution linear 2-D image is specified in local Cartesian coordinate system  $R_{PLIIM/Cartesian}$  symbolically embedded within the PLIIM-based imager, and (ii) the intensity value of the pixel  $I(x',y')$  is associated with the  $x', y'$  Cartesian coordinates of the image detection element in the linear image detection array at which the pixel is detected, and (iii) wherein also the planar laser illumination beam (PLIB) of the PLIIM-based imager is spaced from the amplitude modulated (AM) laser scanning beam of the LDIP subsystem is about D centimeters.

C

A

FIG. 23C1

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A

STEP 4: At the unitary PLIIM-based object imaging and profiling system, capture and buffer the camera (IFD) parameters used to form and detect each linear high-resolution 2-D image captured during the corresponding photo-integration time period  $\Delta T_K$ , by the PLIIM-based imager.

D

STEP 5: At the end of each photo-integration time period  $\Delta T_K$ , use the unitary PLIIM-based object imaging and profiling system to transmit the following information elements to the Image Processing Computer for data storage and subsequent information processing:

(1) the converted coordinates  $x, y, z$ , of each point in the linear 3-D surface profile map of the arbitrary 3-D object surface captured during photo-integration time period  $\Delta T_K$ ;

(2) the measured velocity(ies) of the arbitrary 3-D object surface during photo-integration time period  $\Delta T_K$ ;

(3) the  $x', y'$  coordinates and intensity value  $I(x', y')$  of each pixel in each high-resolution linear 2-D image captured during photo-integration time period  $\Delta T_K$  and specified in the local Cartesian coordinate system  $R_{PLIIM/Carthesian}$ ; and

(4) the captured camera (IFD) parameters used to form and detect each linear high-resolution 2-D image captured during the photo-integration time period  $\Delta T_K$

E

STEP 6: At the Image Processing Computer, receive the data elements transmitted from the PLIIM-based profiling and imaging system during Step 5, buffer data elements (1) and (2) in a first FIFO buffer memory structure, and data elements (3) and (4) in a second FIFO buffer memory structure.

F

B

FIG. 23C2

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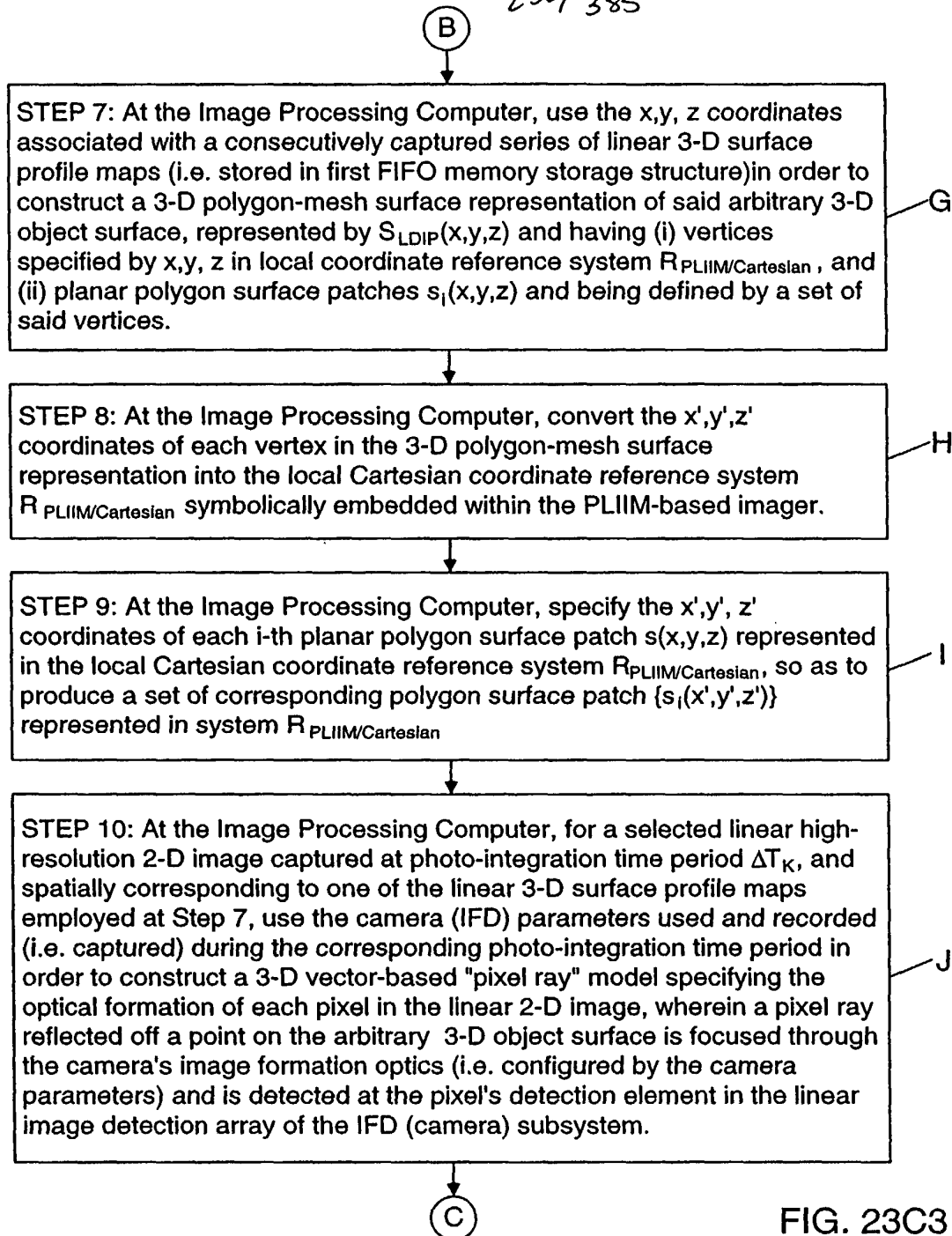


FIG. 23C3



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C

STEP 11: At the Image Processing Computer, for each laser beam ray (producing one of the pixels in said selected linear 2-D image), (i) determine which polygon surface patch  $s_i(x, y, z)$  the pixel ray intersects, (ii) compute the  $x, y, z$  coordinates of the point of intersection (POI) between the pixel ray and the polygon surface patch represented in Cartesian coordinate reference system  $R_{PLIIM/Cartesian}$ , and (iii) designate the computed set of points of intersection as  $\{p_i(x, y, z)\}$ .

K

STEP 12: At the Image Processing Computer, for each laser beam ray passing through a determined polygon surface patch  $s(x', y', z')$  at a computed point of intersection  $p_i(x, y, z)$ , assign the intensity value  $I(x', y')$  of the pixel ray to the  $x', y', z'$  coordinates of the point of intersection, thereby producing a linear high-resolution 3-D image comprising a 2-D array of pixels, each said pixel pixel having as its attributes (i) an Intensity value  $I(x', y', z')$  and (ii) coordinates  $x', y', z'$  specified in the local Cartesian coordinate reference system  $R_{PLIIM/Cartesian}$ .

L

STEP 13: Put the computed linear high-resolution 3-D image in a third FIFO memory storage structure in the image processing computer.

M

STEP 14: Repeat Steps 1-6 to update the first and second FIFO data queues maintained in the image processing computer, and Steps 7-13 to update the consecutively computed linear high-resolution 3-D image stored in the third FIFO memory storage structure.

N

STEP 15: Assemble in an image buffer in the image processing computer, a set of consecutively computed linear high-resolution 3-D images retrieved from the third FIFO data storage device so as to construct an "area-type" high-resolution 3-D image of said arbitrary 3-D object surface.

O

D

FIG. 23C4

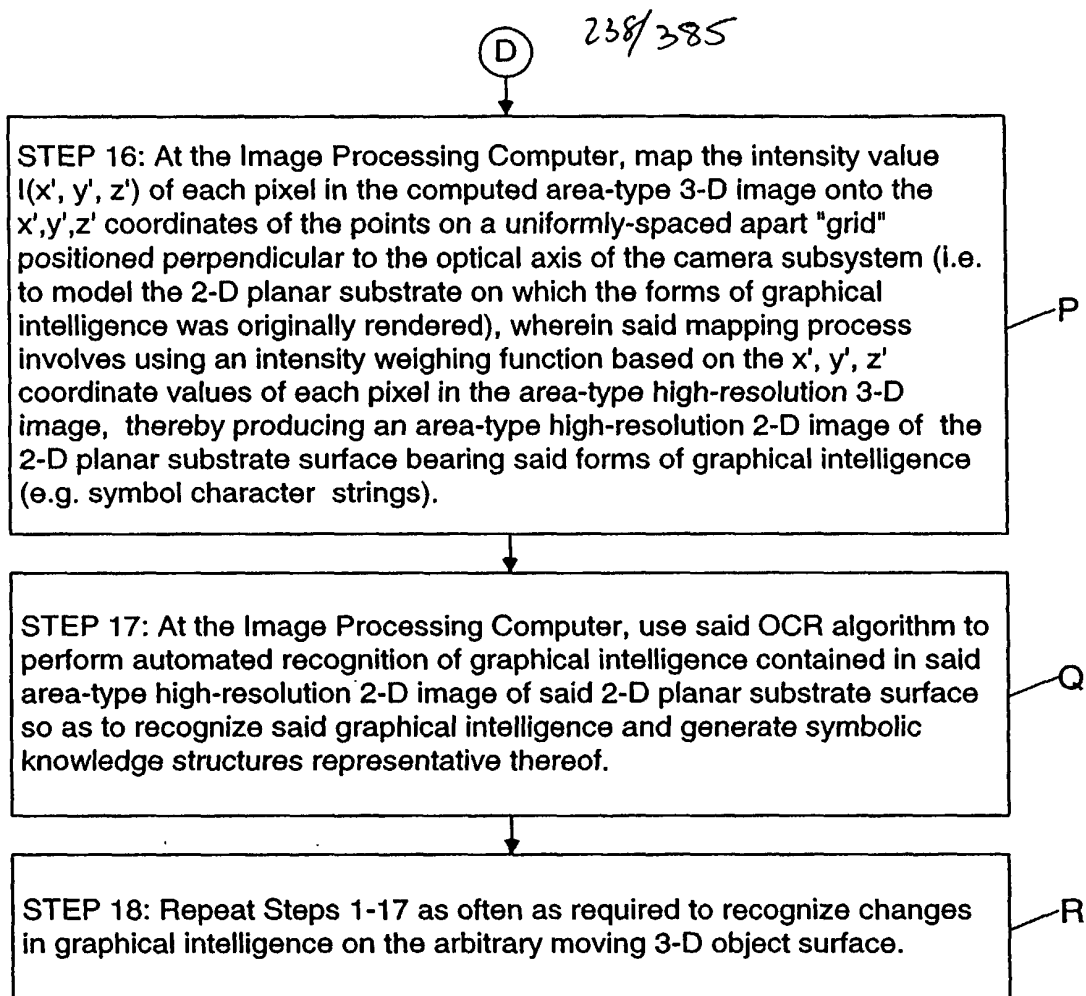
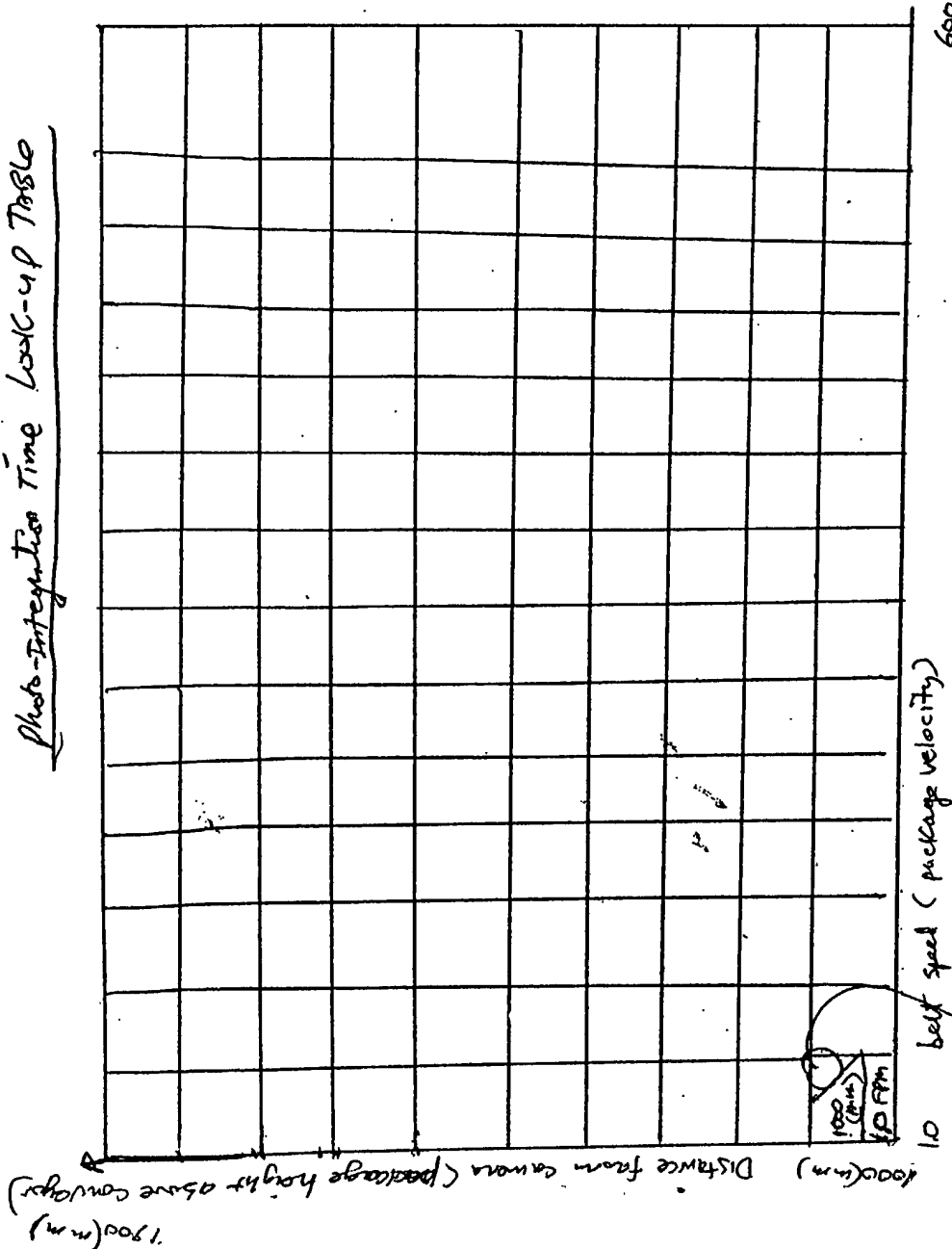


FIG. 23C5

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Photo-Integration Time Look-up Table



600 feet per minute  
(FPM)

FIG. 22B

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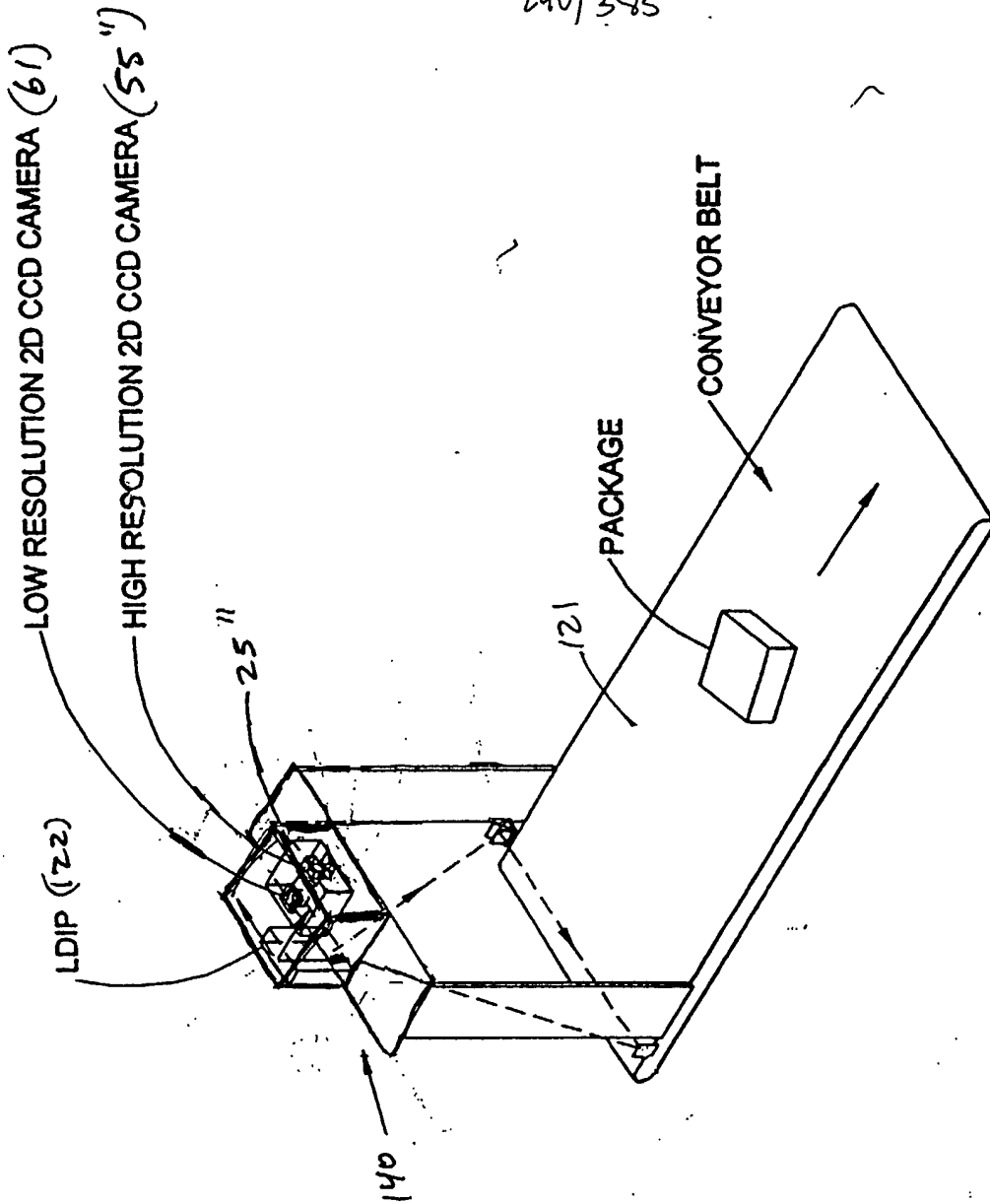


FIG 24

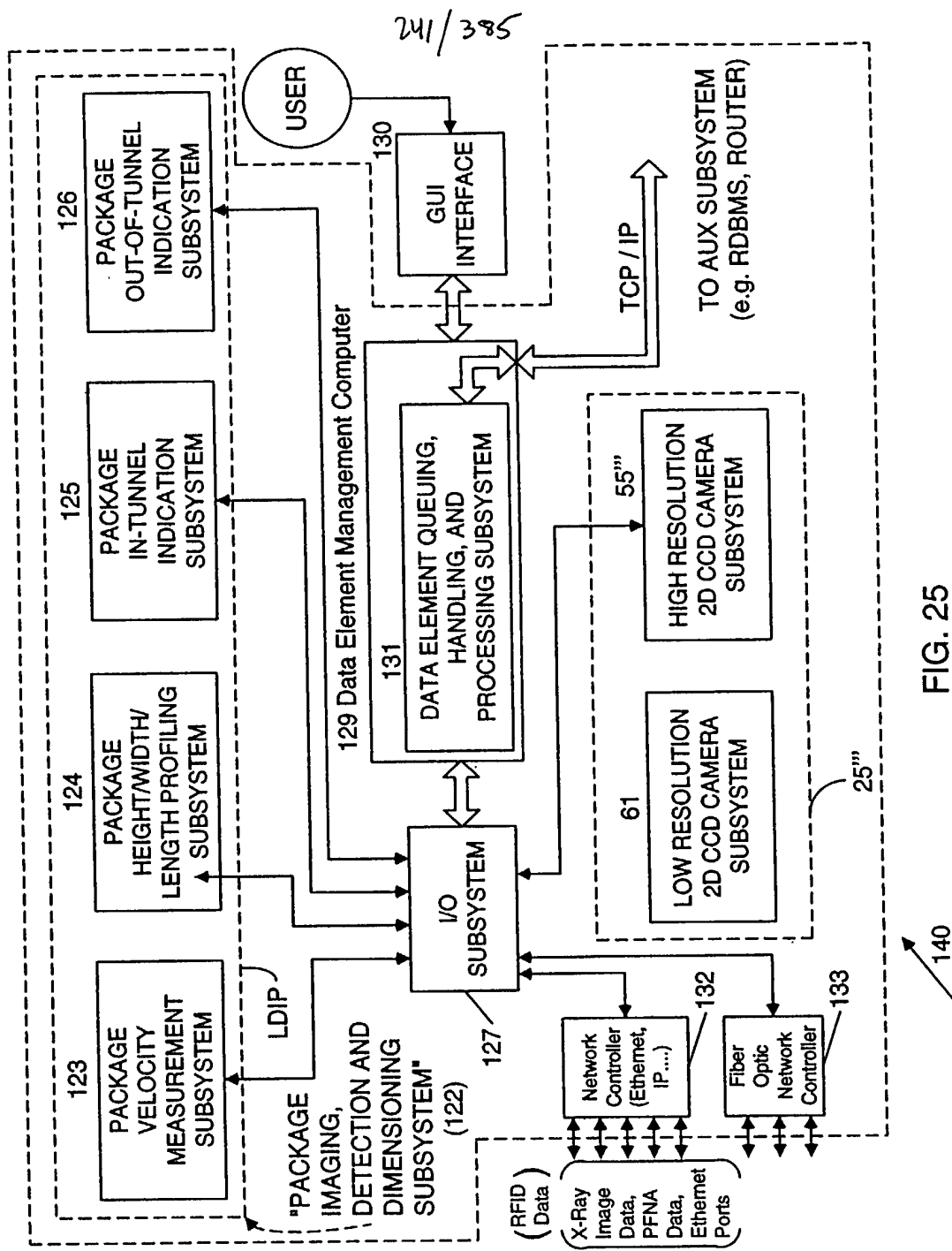


FIG. 25

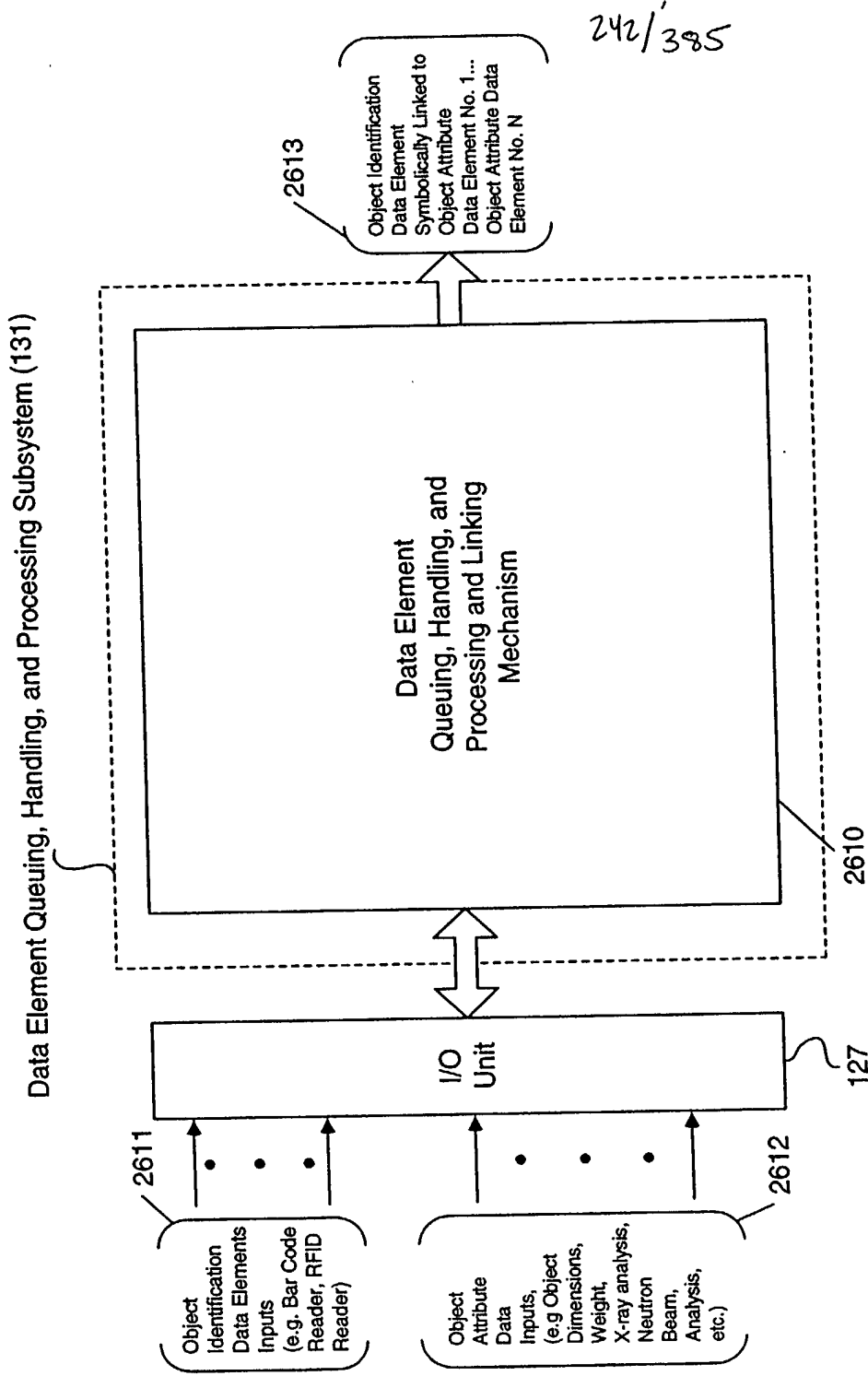


FIG. 25A

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Primary Network:  
and/or System  
Functions:

A. Specification of Object  
Detection and  
Tracking Capability of  
System

B. Specification of Object  
Identification  
Capability of System

C. Specification of  
Object Attribute  
Acquisition Capability  
of System

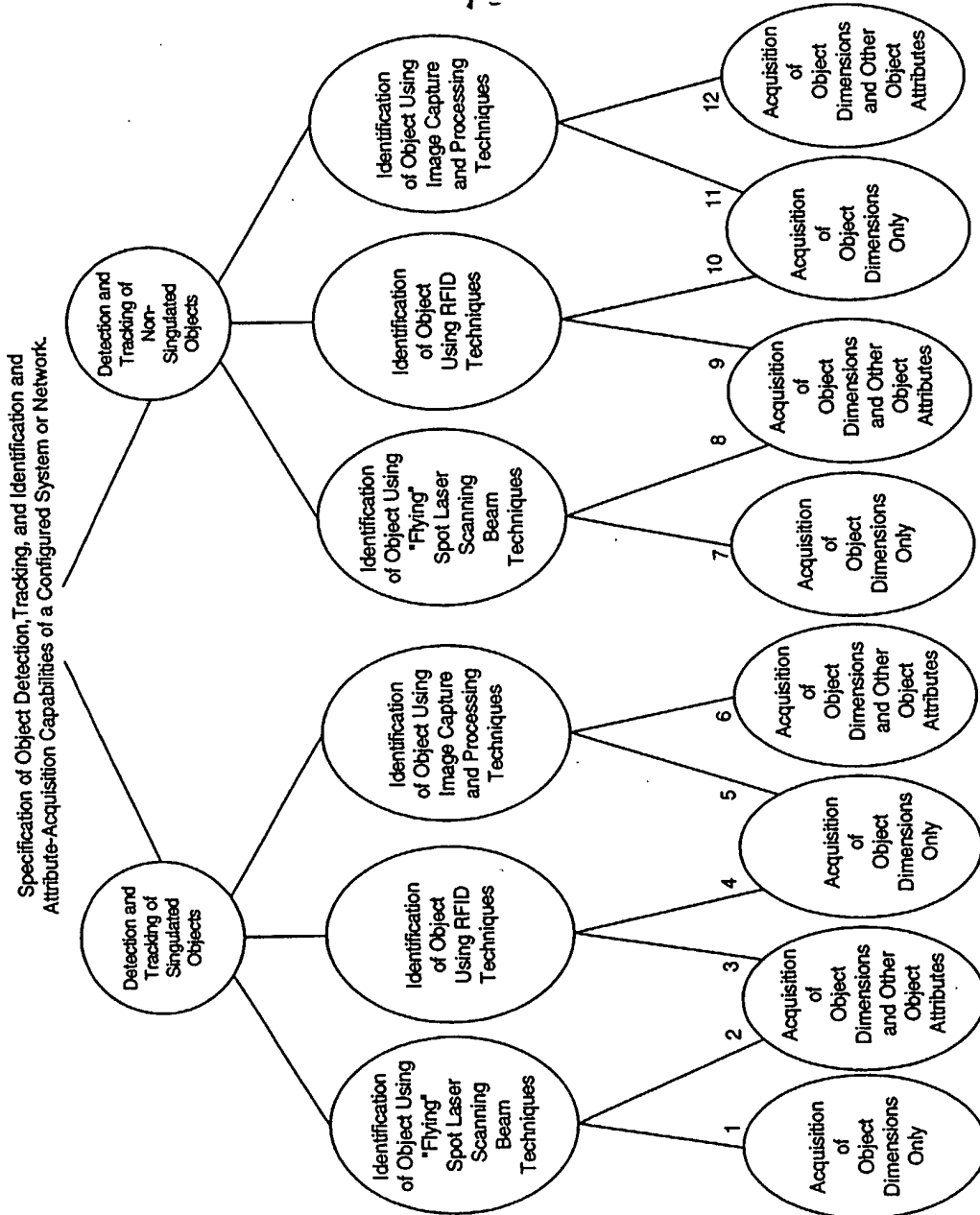


FIG. 25B

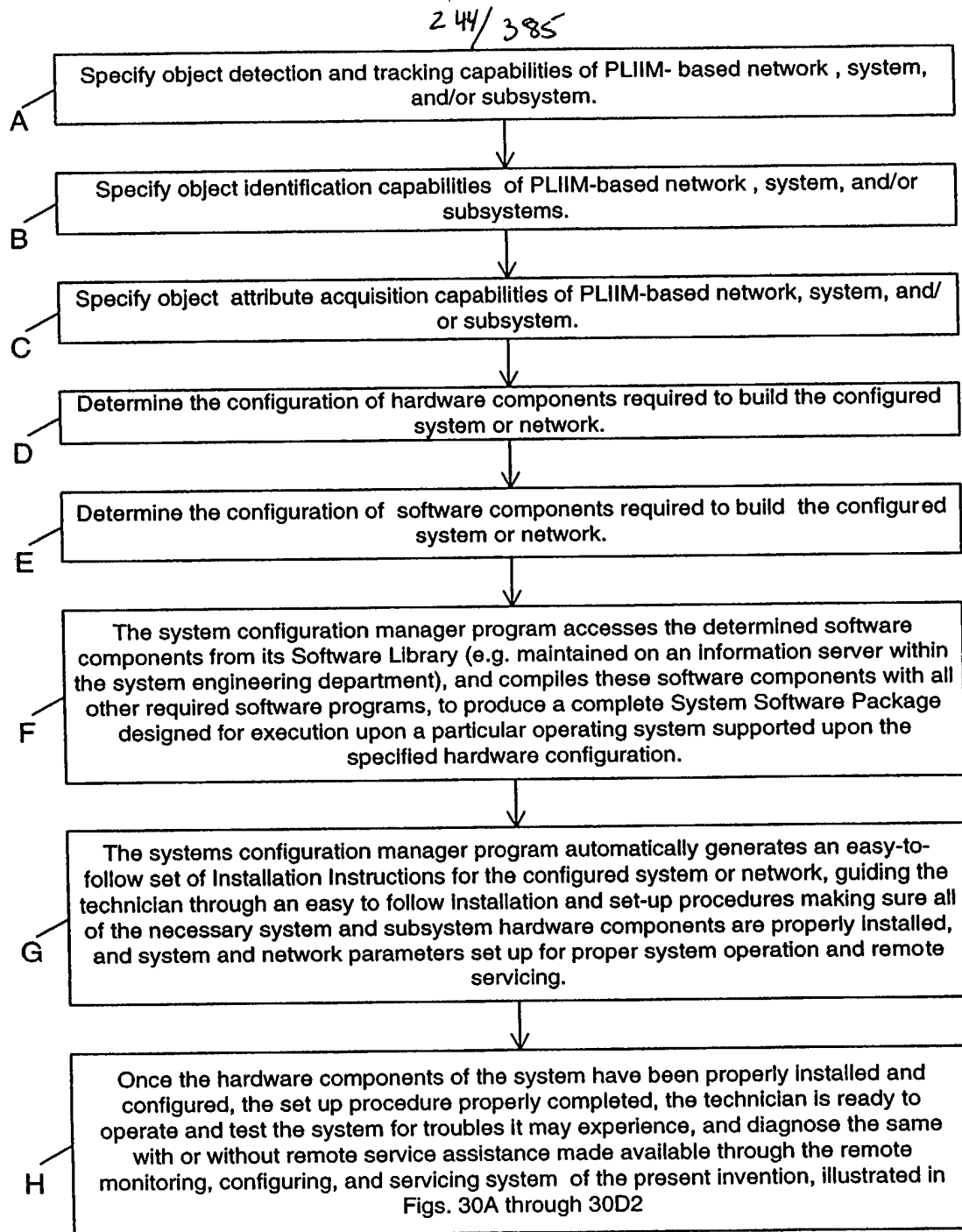


FIG. 25C



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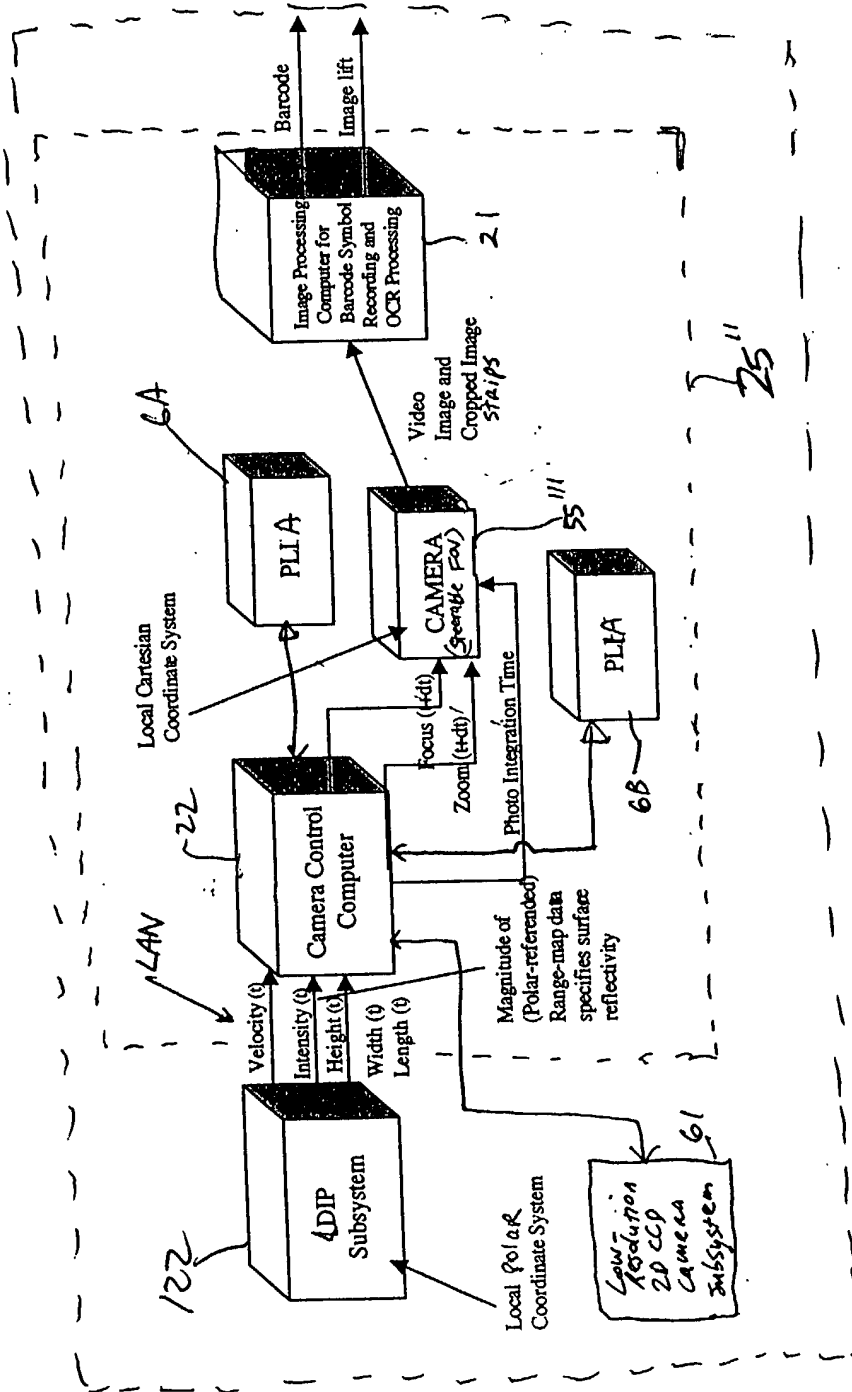
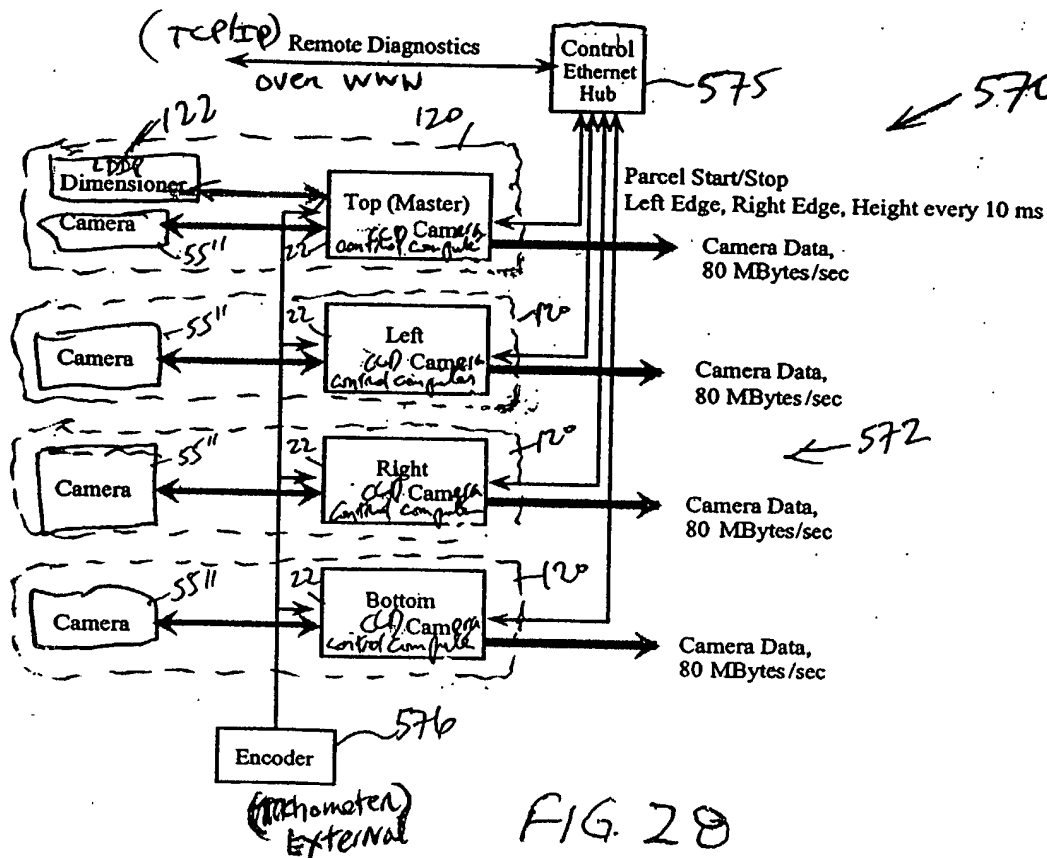
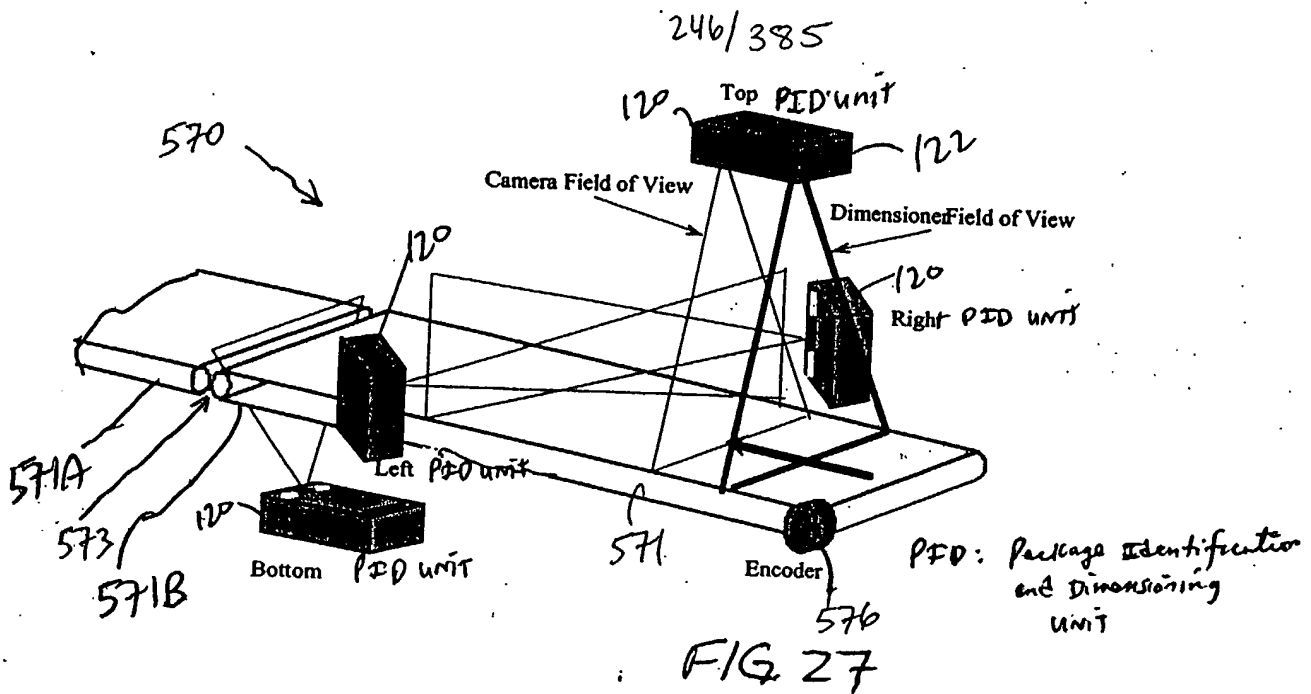


FIG. 26



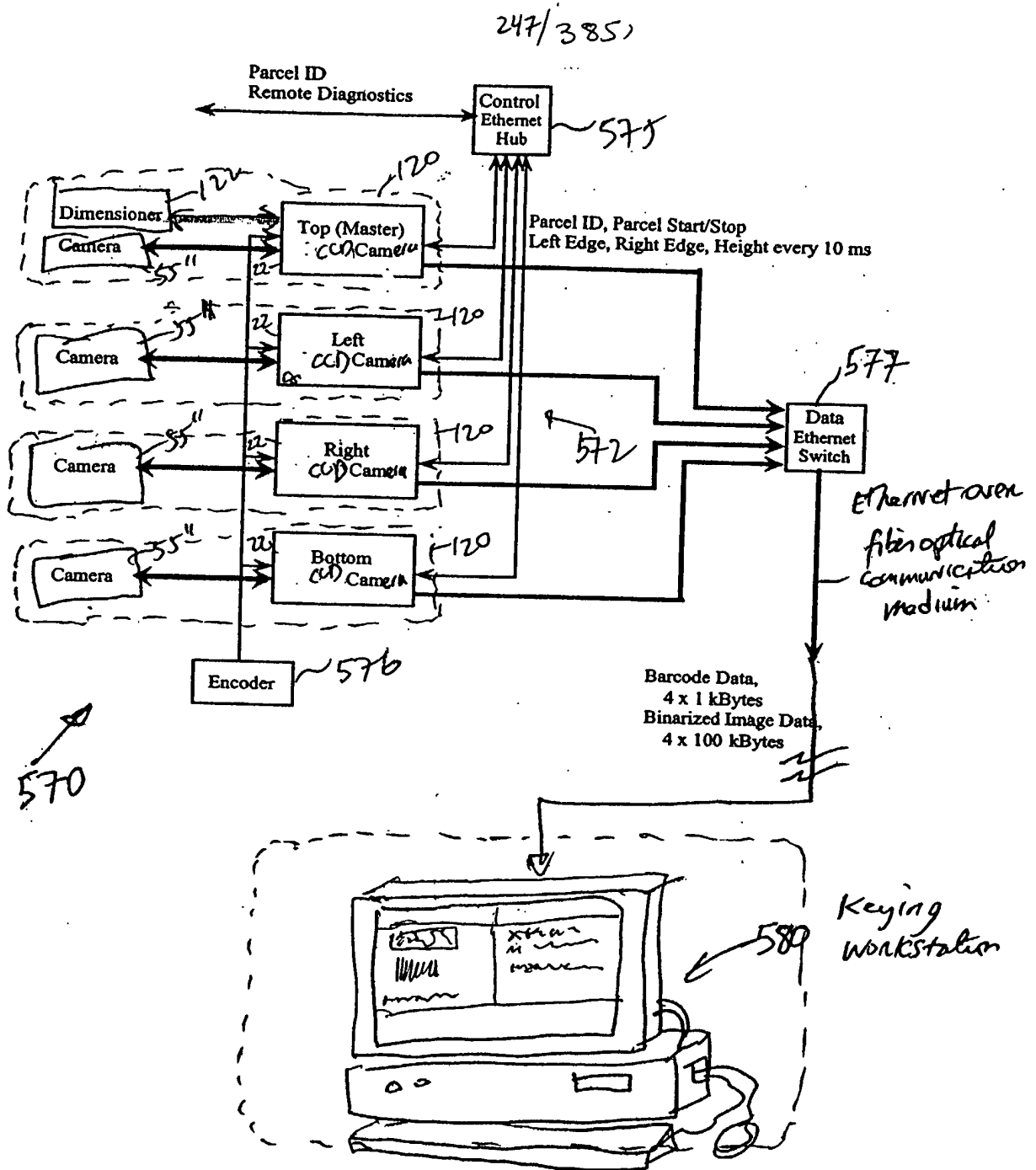


FIG. 29

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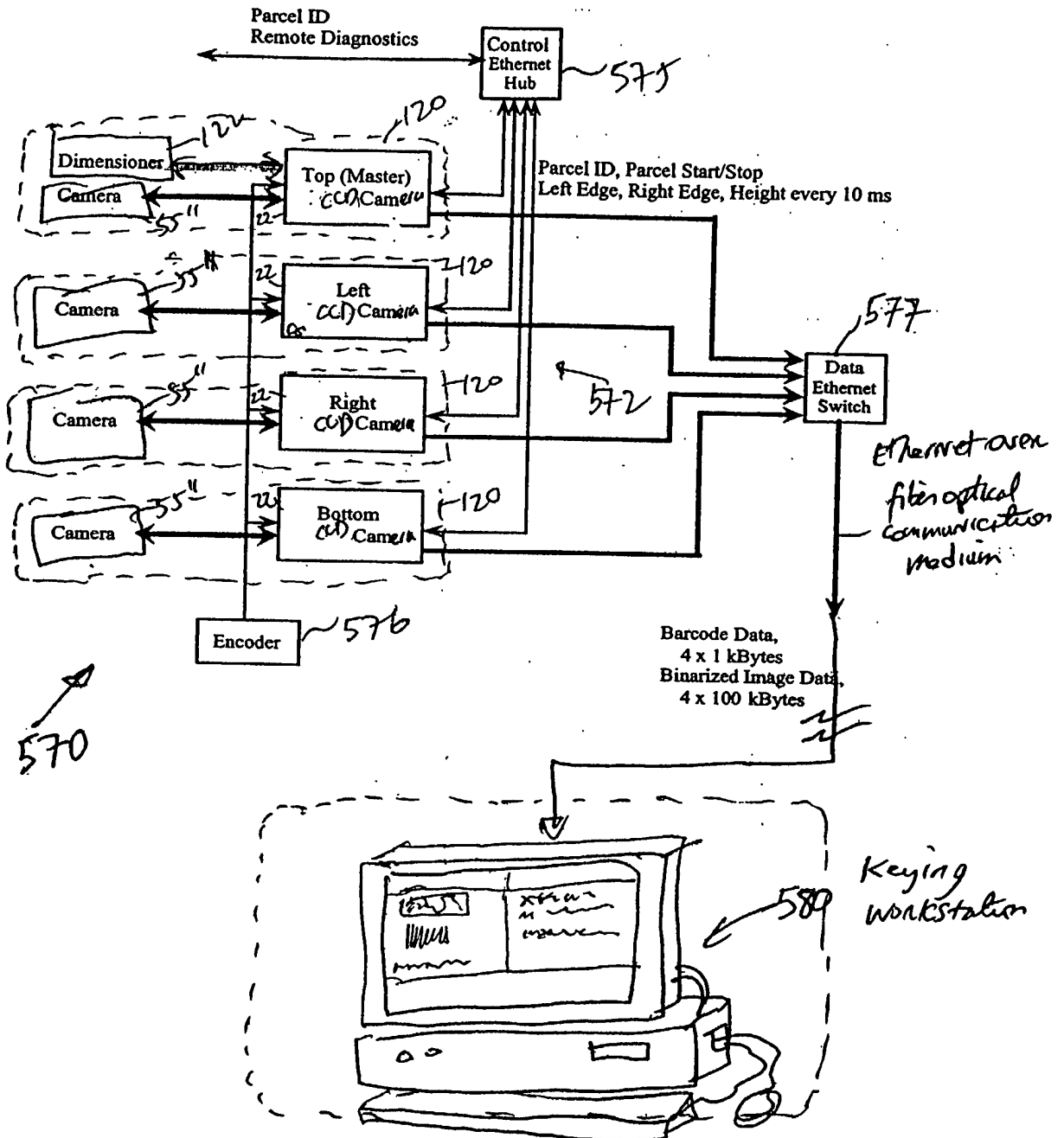
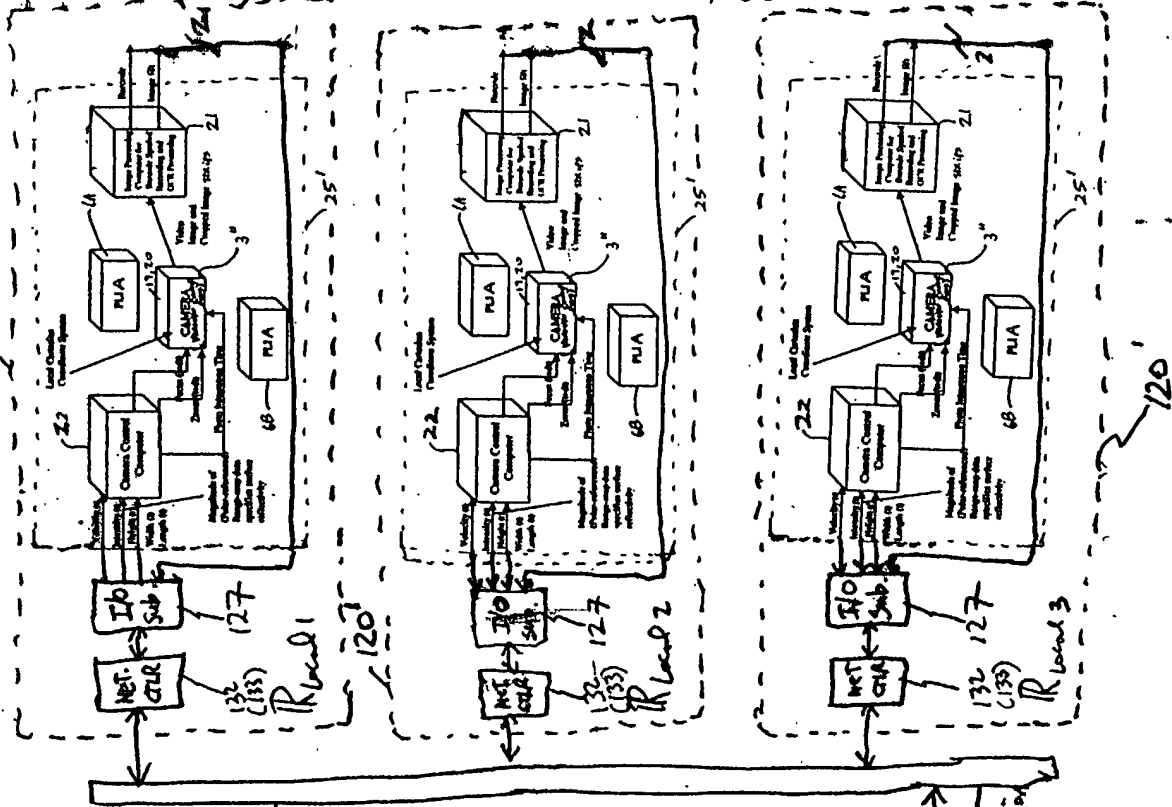


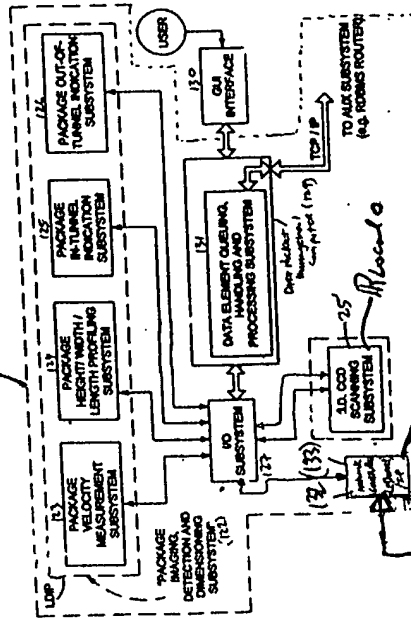
FIG. 29

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570

120



Coordinate Data  
Reference  
with respect to  
Global  
Velocity (t)  
Intensity (t)  
Height (t)  
Width (t)  
Length (t)

Network  
Communication  
Medium

FIG 30

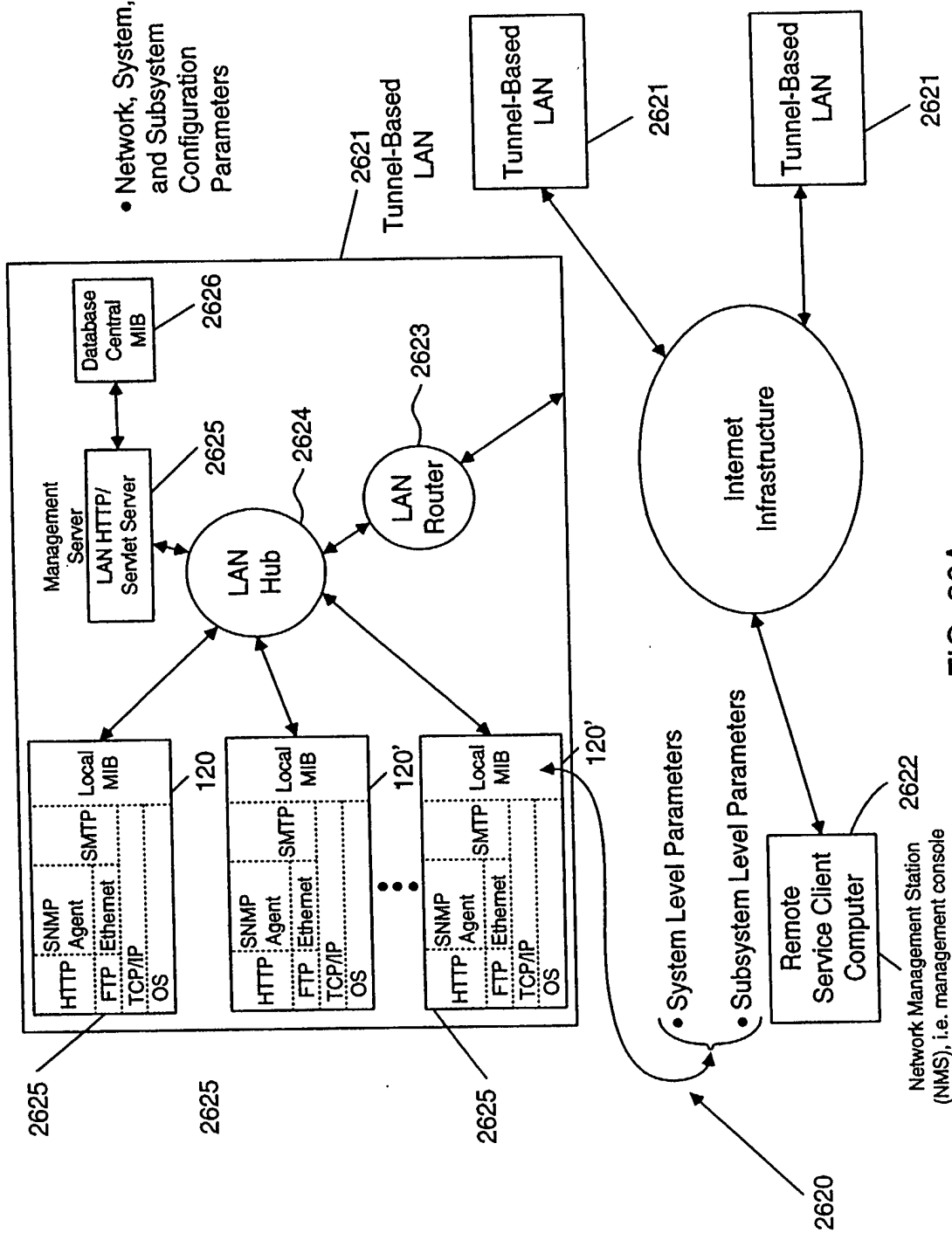
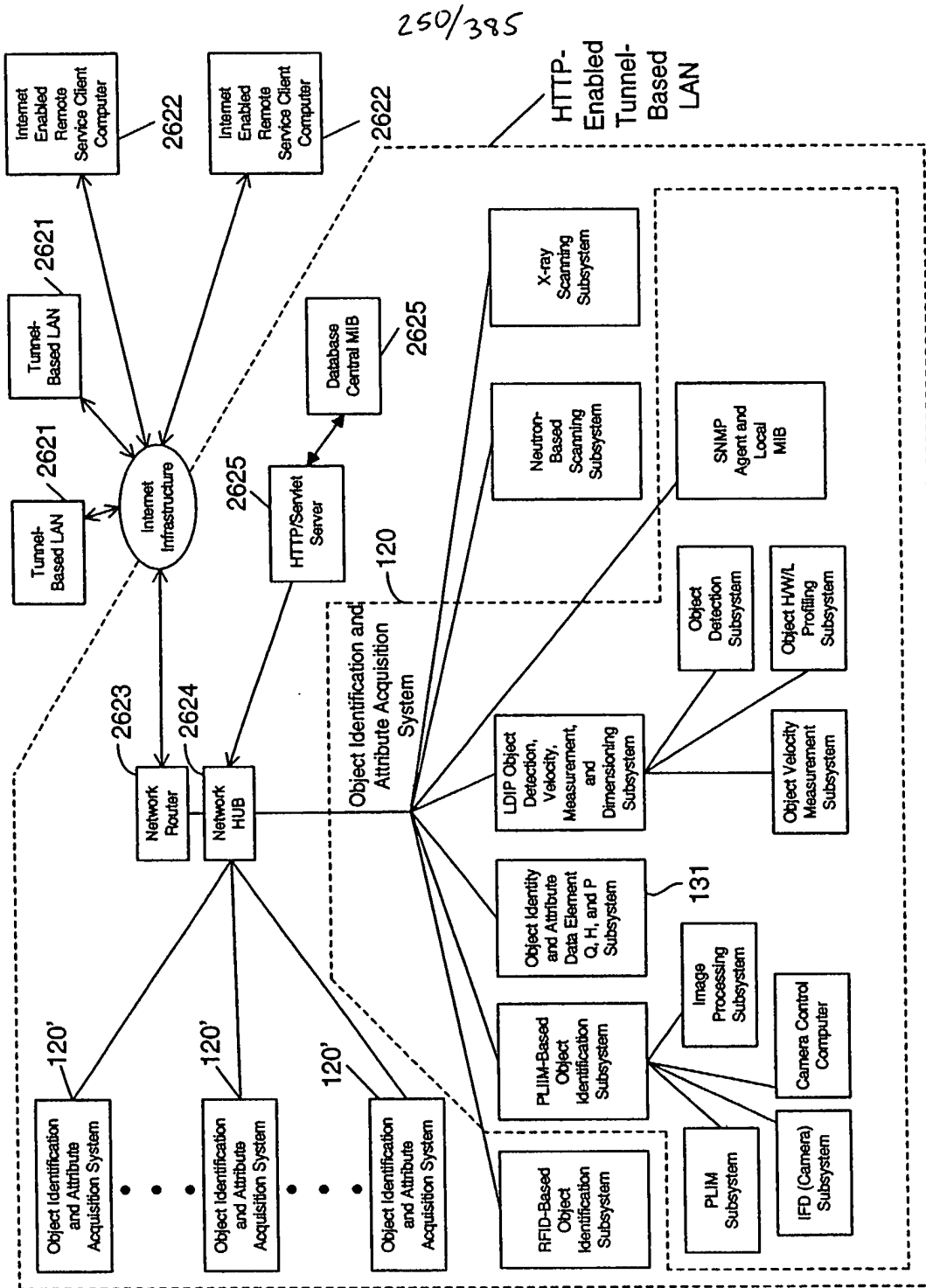


FIG. 30A



**FIG. 30B**

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**Network Configuration Parameters:**

[ Router IP address; no. of nodes (i.e. systems) in LAN; passwords, LAN location; name of customer facility; technical contact; phone no.; domain name; object identity codes; object attribute acquisition codes;.....]

**System Configuration Parameters:**

[ System IP Address; passwords; object identity codes; object attribute acquisition codes;.....]

**Monitorable and/or Configurable Parameters for Subsystems Within Each System:**

- |  |  |
|--|--|
| <p>These subsystems generate object identity parameters</p>  | <p><input type="checkbox"/> PLIIM-based object identification subsystem: [ object identity code; object attribute acquisition codes;.....]</p> <p><input type="checkbox"/> PLIM Subsystem: [VLD status; power VLD; TIM function; temp;.....]</p> <p><input type="checkbox"/> IFD ( Camera) Subsystem: [sensor temp; .....]</p> <p><input type="checkbox"/> Image Processing Subsystem (Computer): [processor load history; system up time; # of frames (pgs); barcode read rate; current line rate;.....]</p> <p><input type="checkbox"/> Camera Contact Subsystem (Computer): [number of frames dropped; number of focused zoom commands; number and kinds of motor control errors;.....]</p> |
| <p>This system links object attribute data element parameters (i.e. object identity data element) to corresponding object identity parameters (i.e. object attribute data element)</p> | <p><input type="checkbox"/> RFID-based object identification subsystem: [....]</p> <p><input type="checkbox"/> Object identity and attribute data element queuing, handling and processing subsystem: [....]</p>   |
| <p>These subsystems generate object attribute parameters</p>   | <p><input type="checkbox"/> LDIP object identification, velocity-measurement, and dimensioning subsystem: [....]</p> <p><input type="checkbox"/> Object velocity measurement subsystem: [polygon RPM; polygon laser output X; channel X drift; channel X noise; trigger error events; instant lock reference drift; temperature]</p> <p><input type="checkbox"/> Object HWW/L profiling subsystem</p> <p><input type="checkbox"/> Object detection subsystem: [non- singulation/ singulation code;.....]</p> <p><input type="checkbox"/> X-ray scanning subsystem: [....]</p> <p><input type="checkbox"/> Neutron-beam scanning subsystem: [....]</p>  |

FIG. 30C



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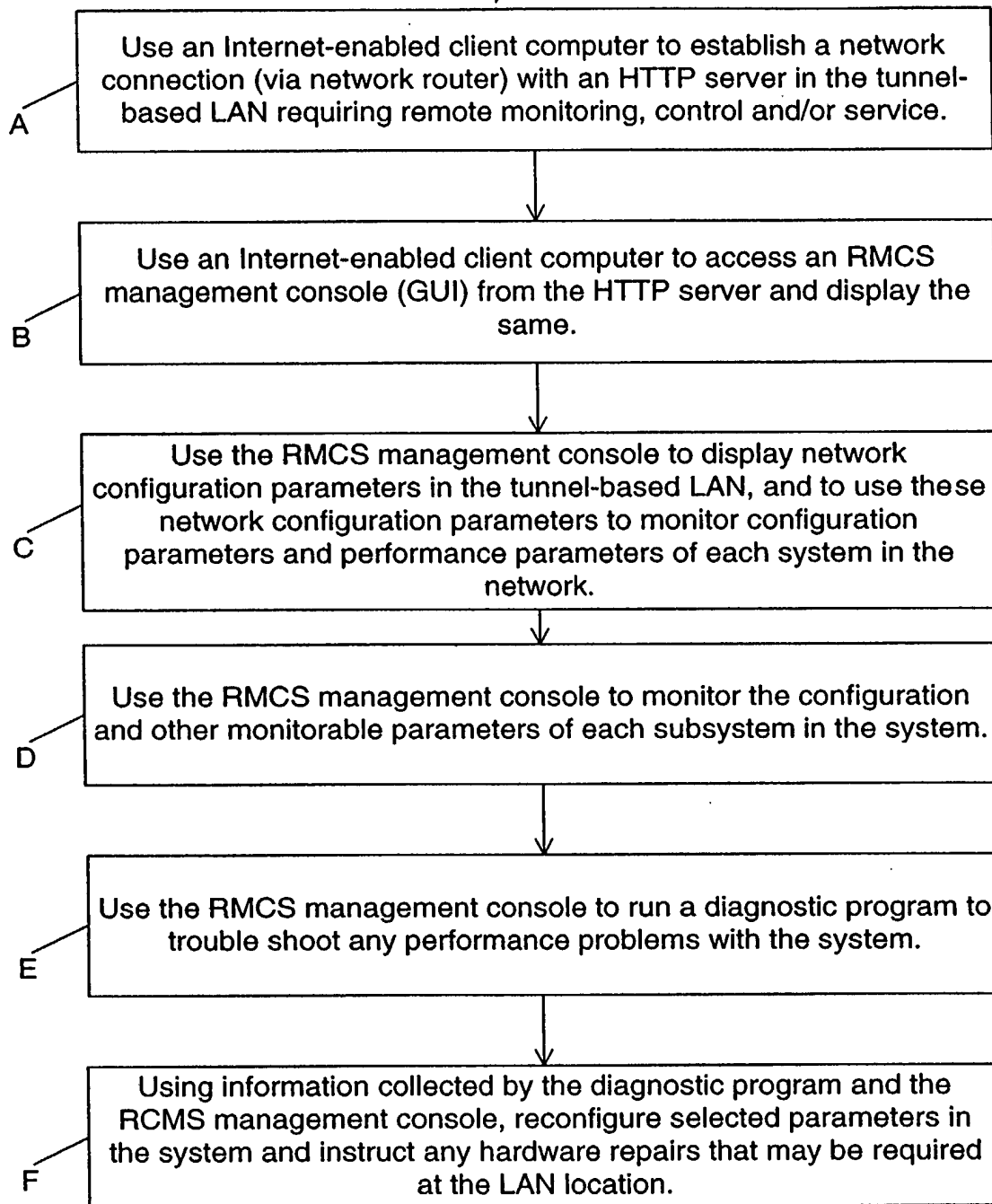


FIG. 30D1

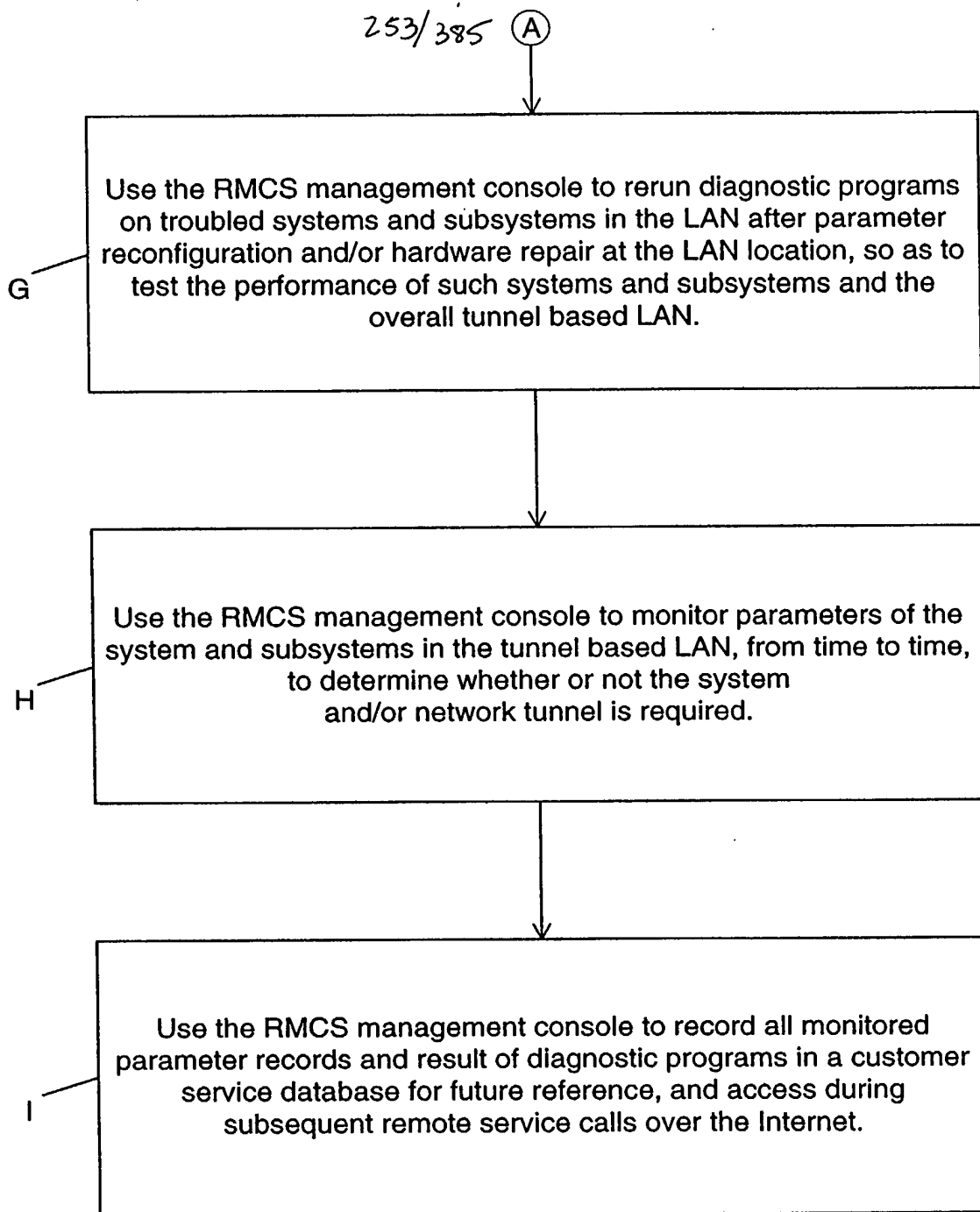


FIG. 30D2

CCD Camera-Based Tunnel System  
Employing Package Coordinate Data  
Driven Method of Automatic Camera  
Zoom and Focus Control

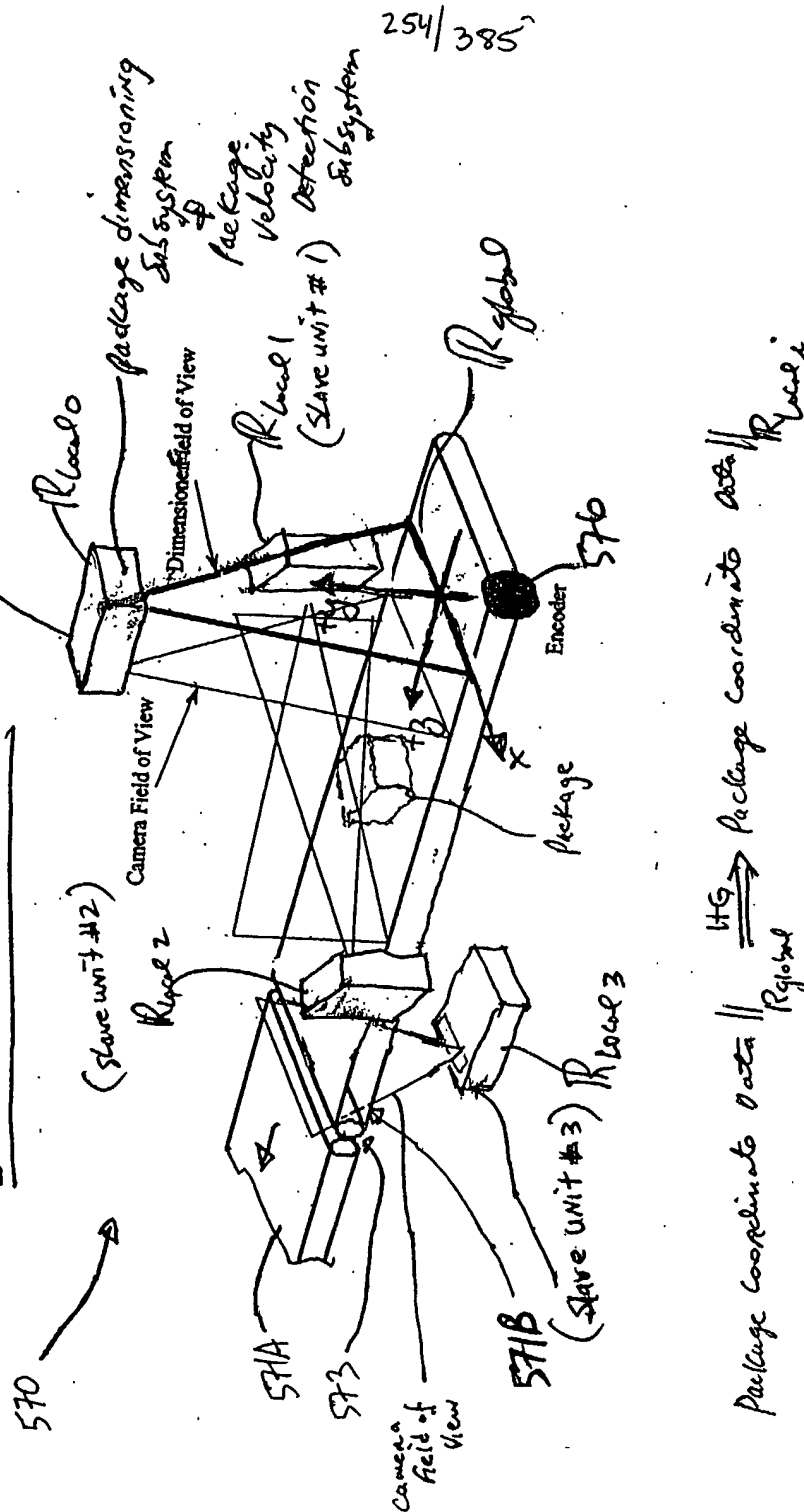


FIG. 31

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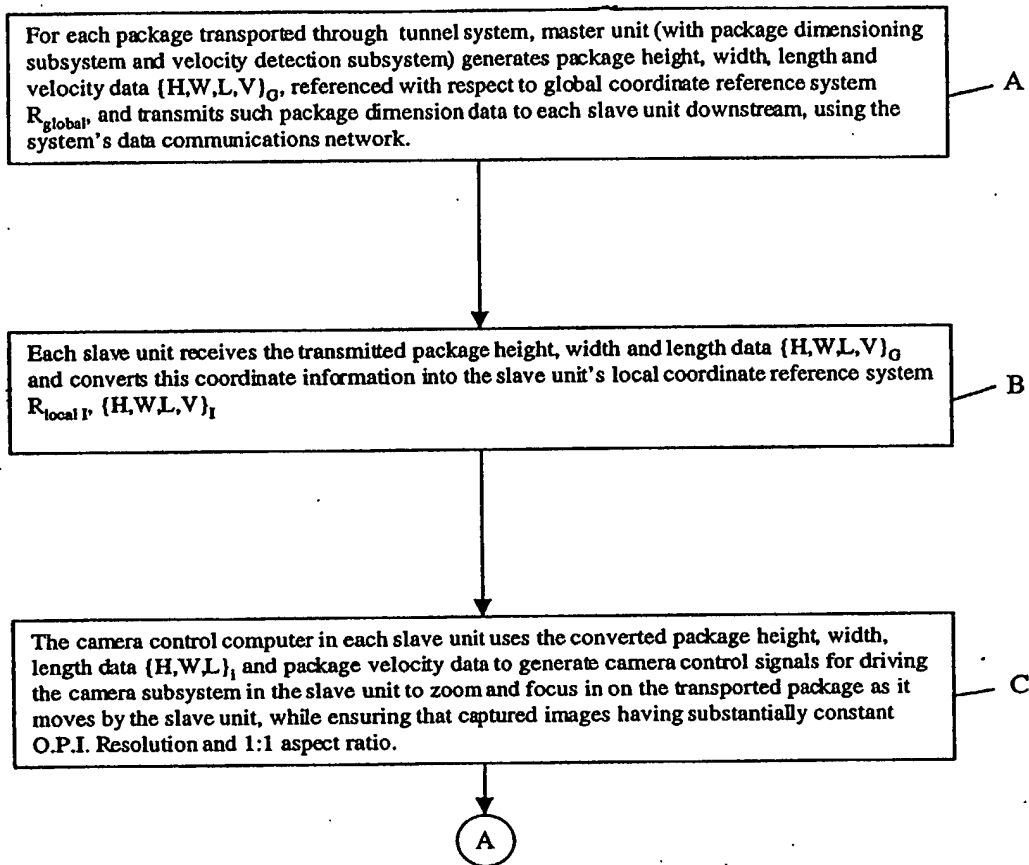


FIG. 32A

(A)

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Each slave unit captures images acquired by its intelligently controlled camera subsystem, buffers the same, and processes the images to decode bar code symbol identifiers represented in said images, and/or to perform optical character recognition (OCR) thereupon.

D

The slave unit which decodes a bar code symbol in a processed image automatically transmits a package identification data element (containing symbol character data representative of the decoded bar code symbol) to the master unit (or other designated system control unit employing data element management functionalities) for package data element processing.

E

Master unit time-stamps received package identification data element, places said data element in a data queue, and processes package identification data elements and time-stamped package dimension data elements in said queue to link each package identification data element with one said corresponding package dimension data element.

F

FIG. 32B

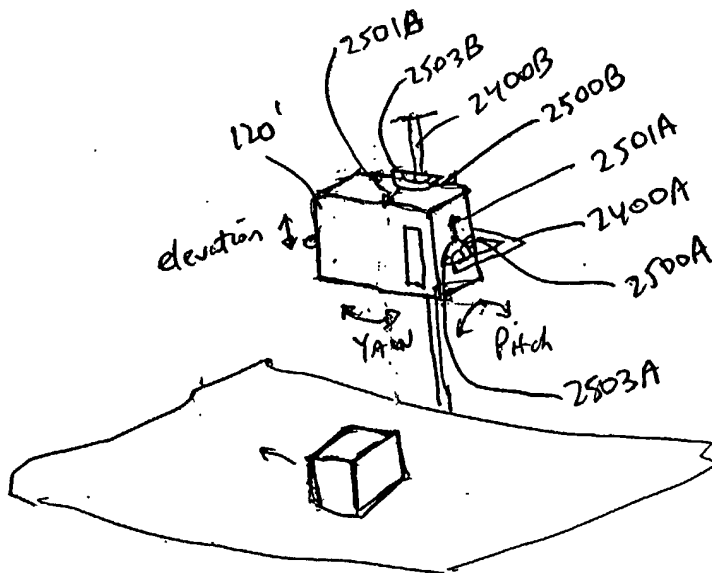
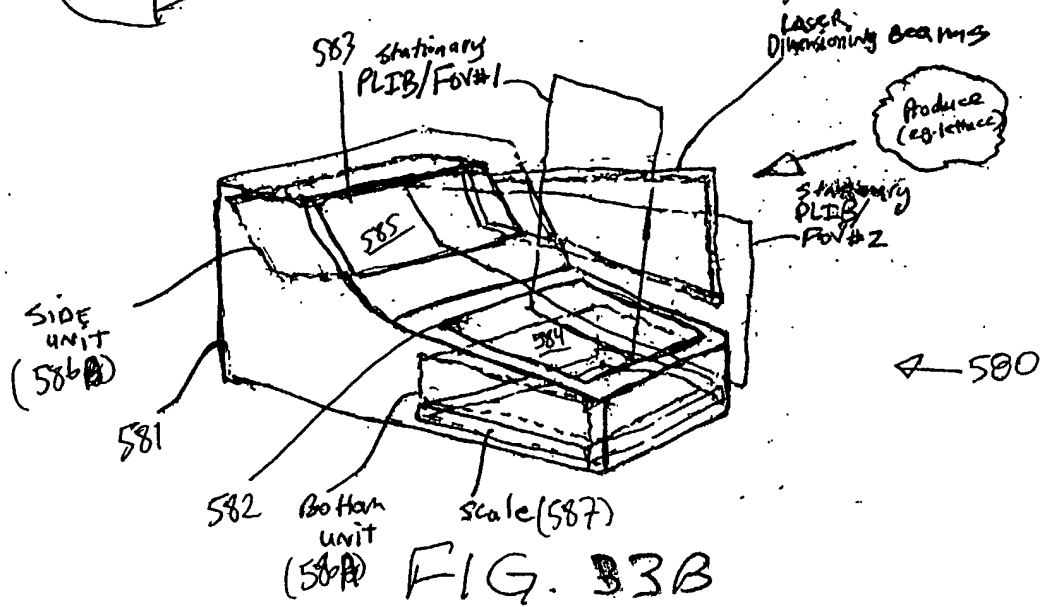
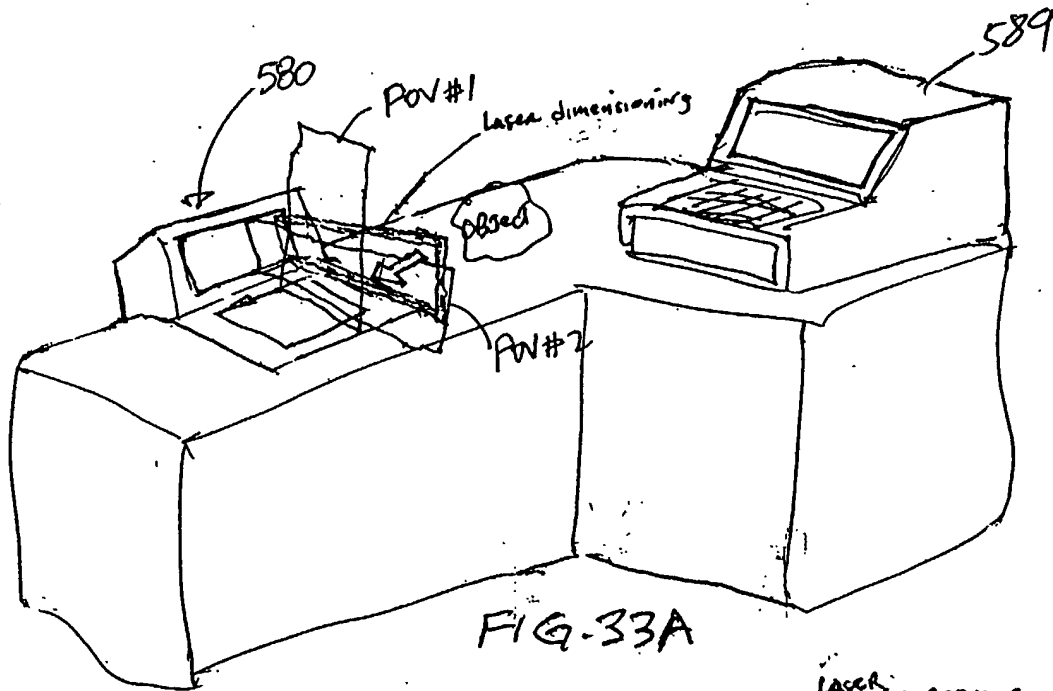


FIG. 31A

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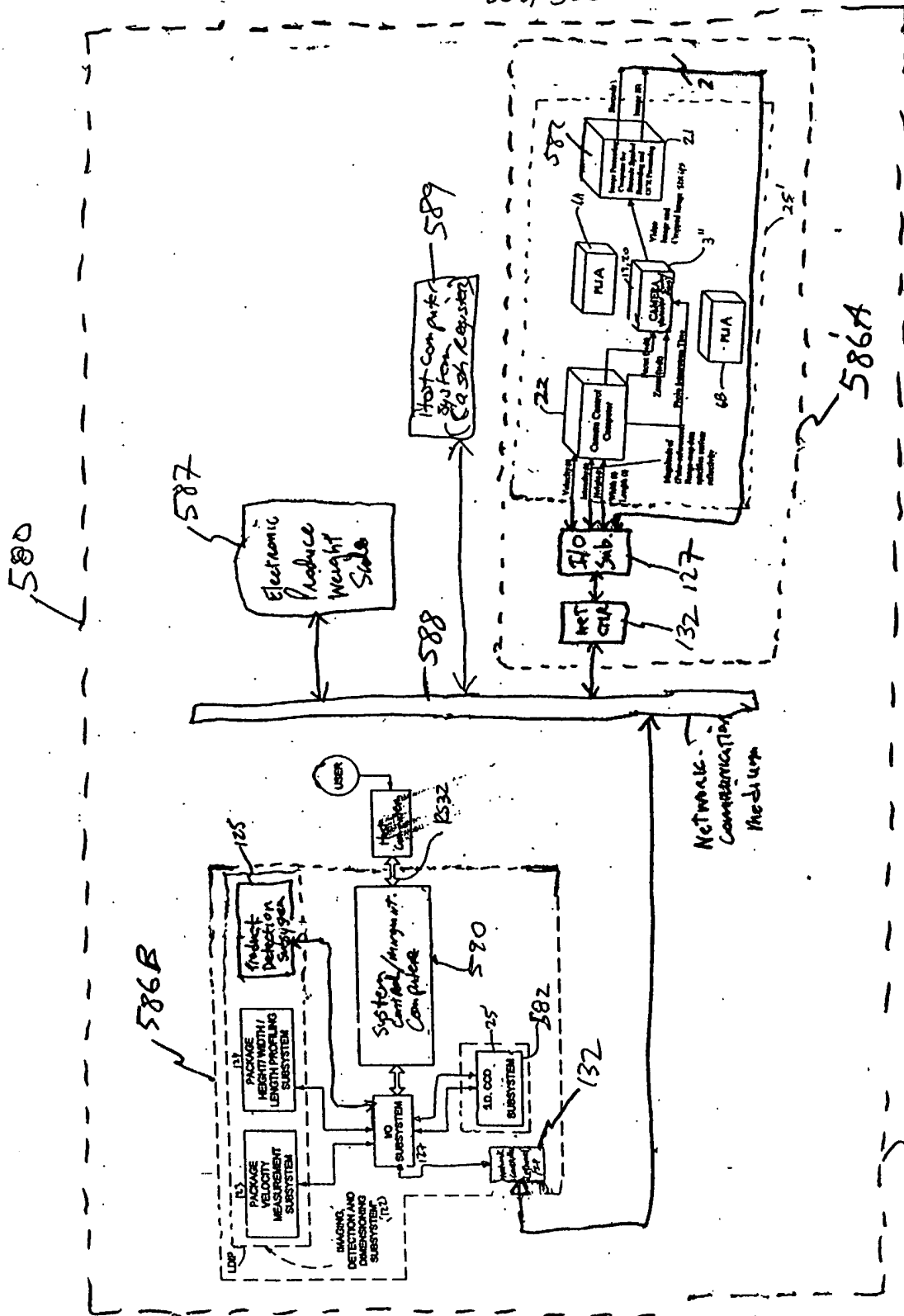


FIG. 33C

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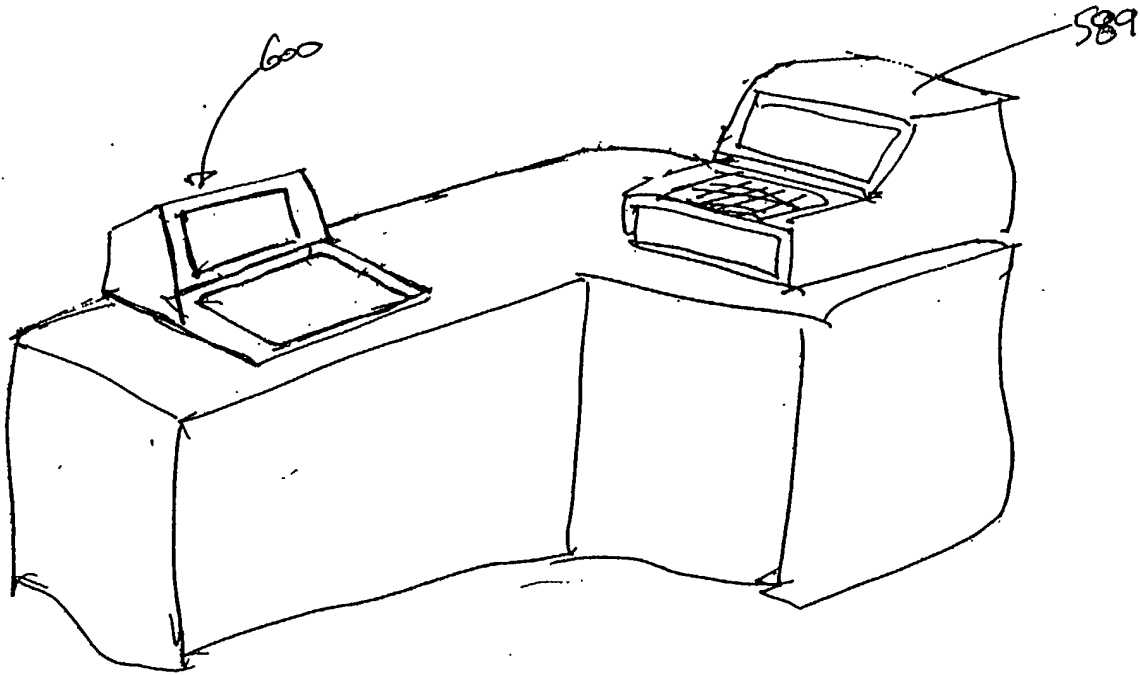


FIG. 34A

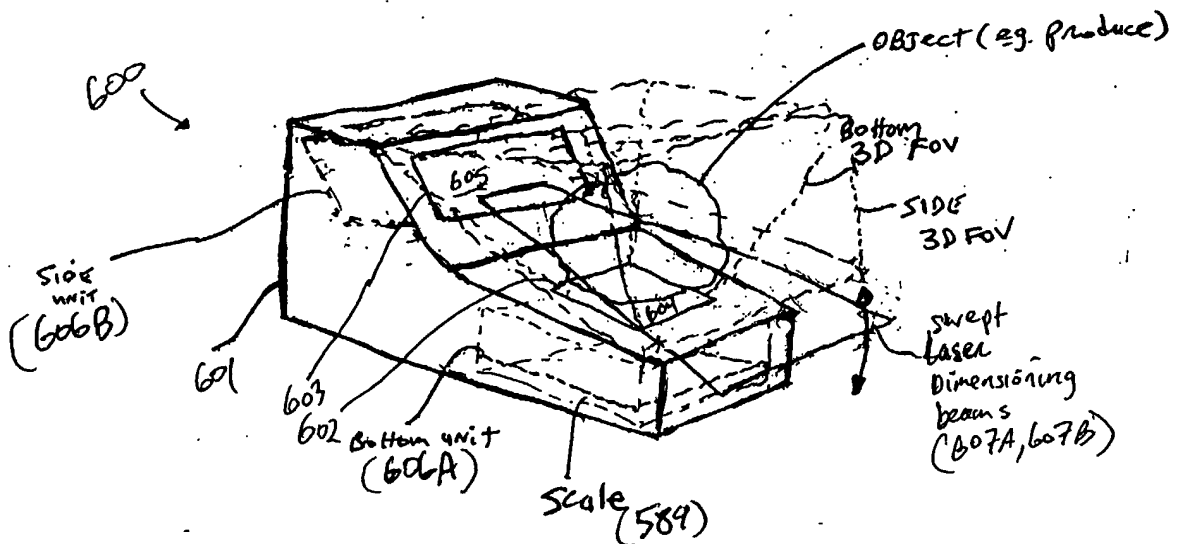
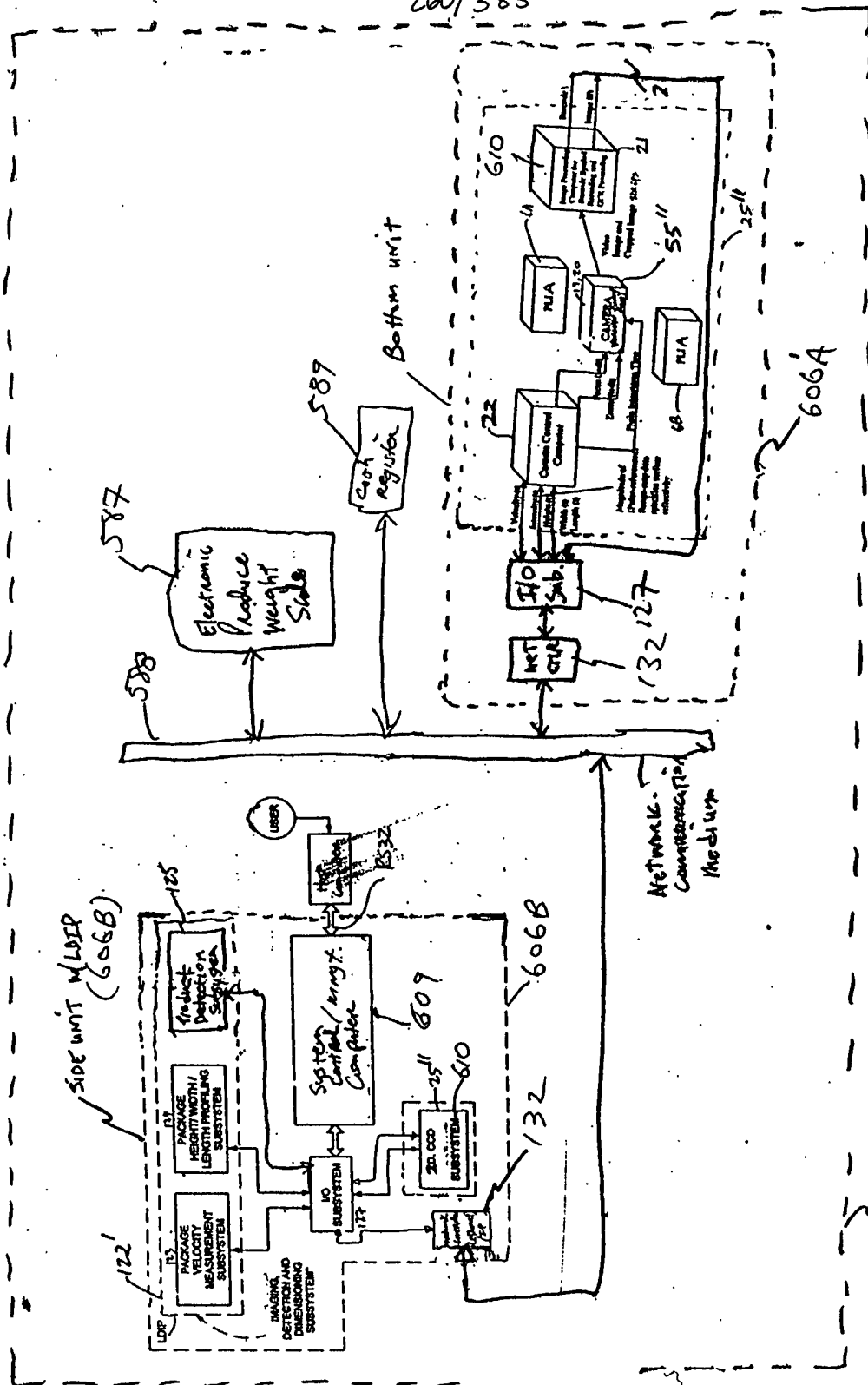


FIG. 34B

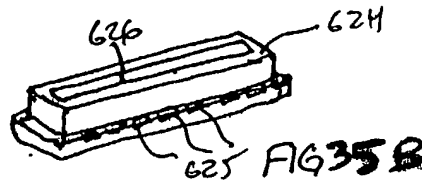
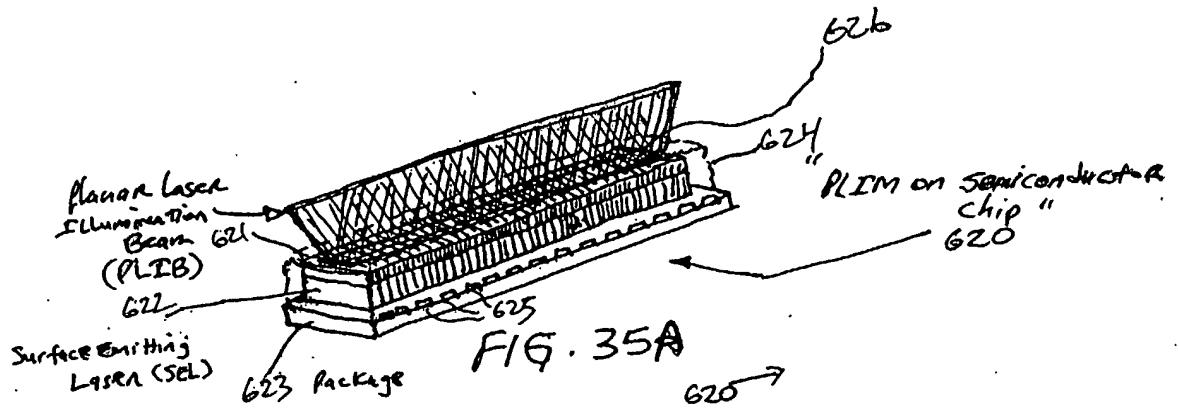


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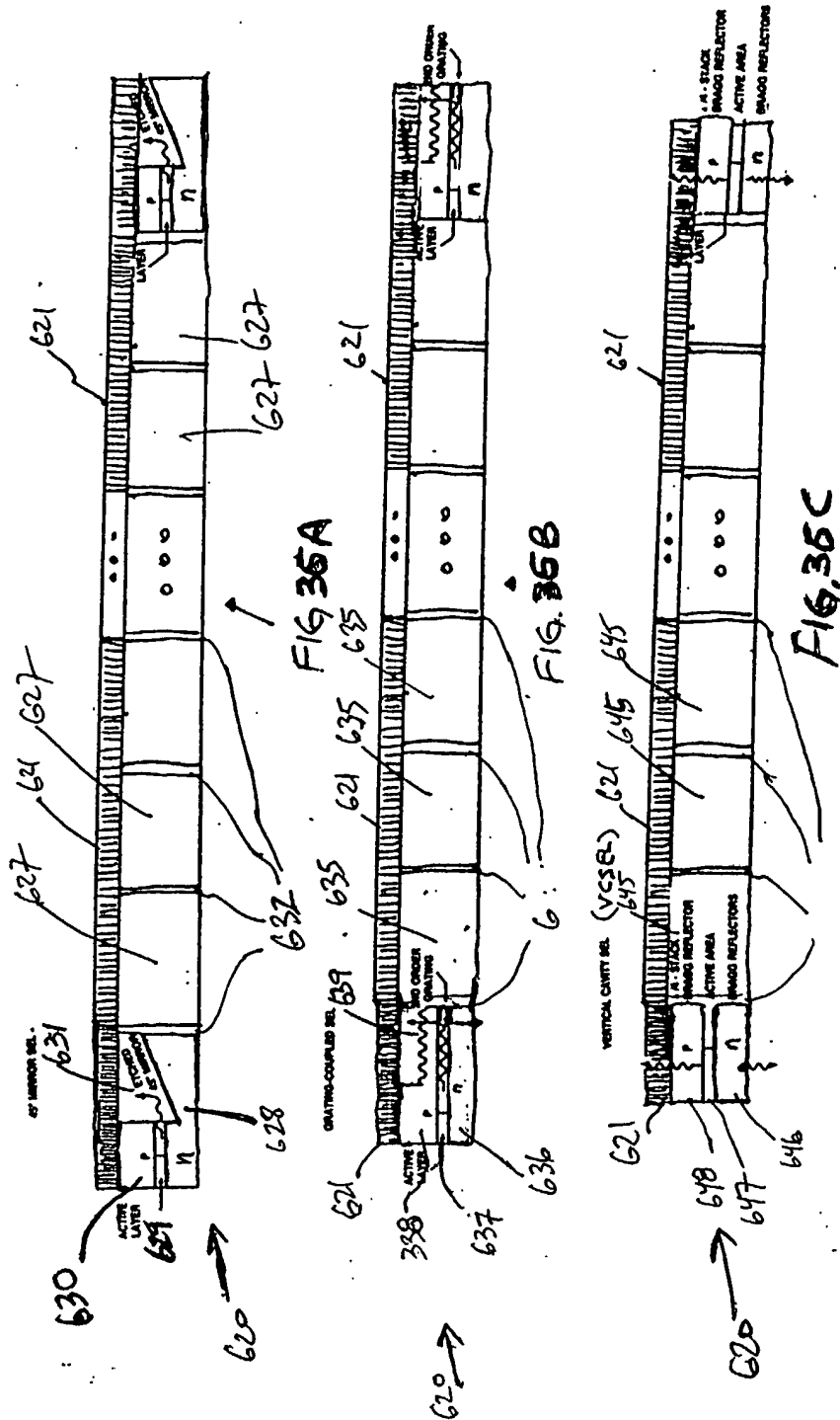


600

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2 63/3857

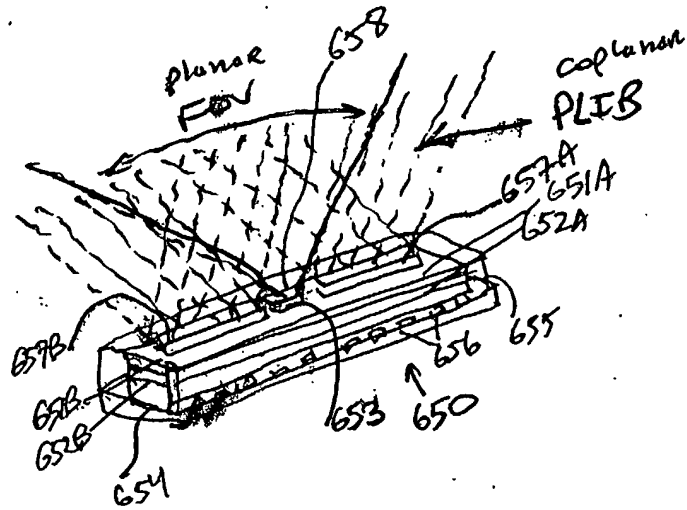


FIG. 37

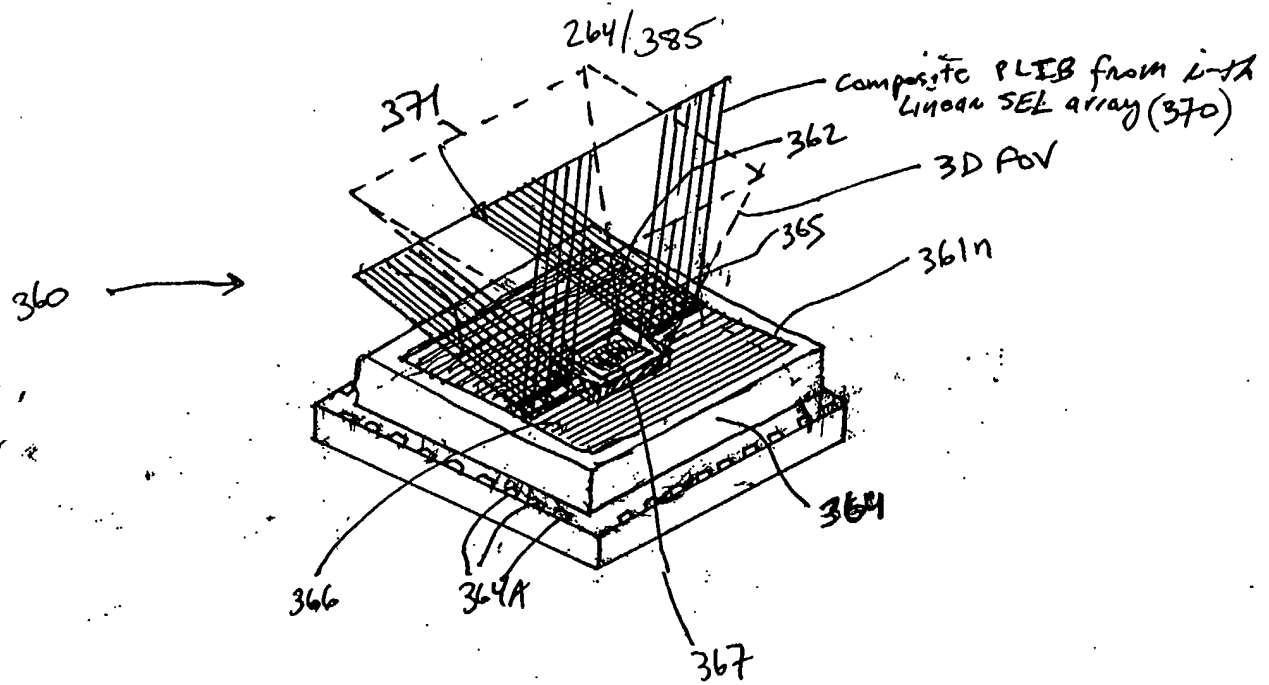


FIG. 38A

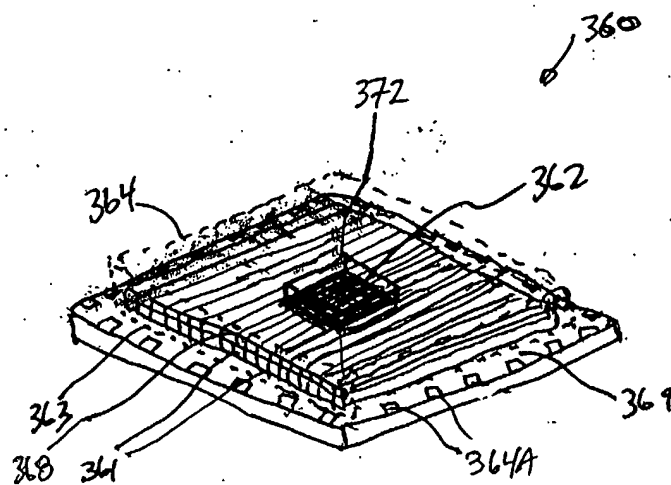


FIG. 38B

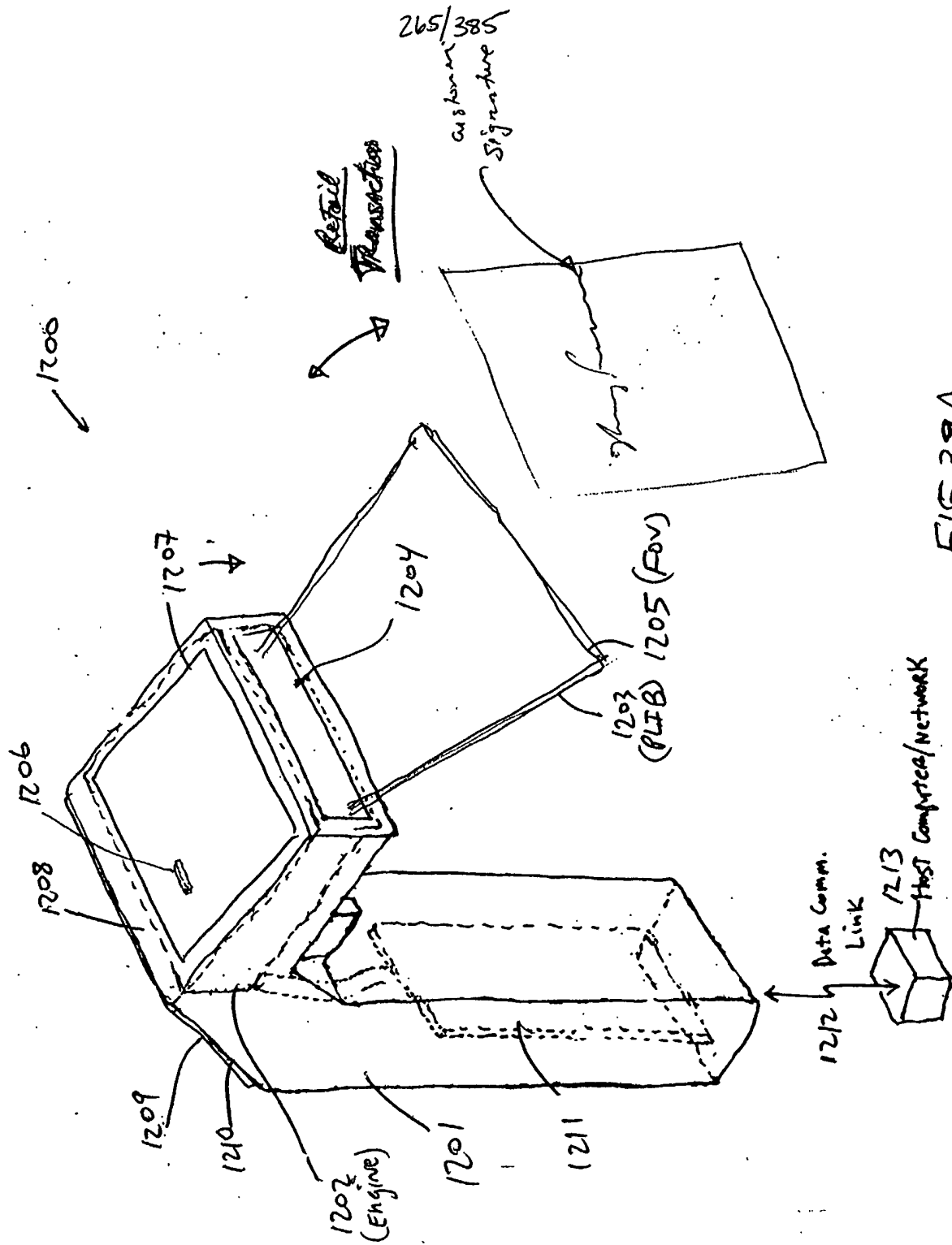


FIG. 39A

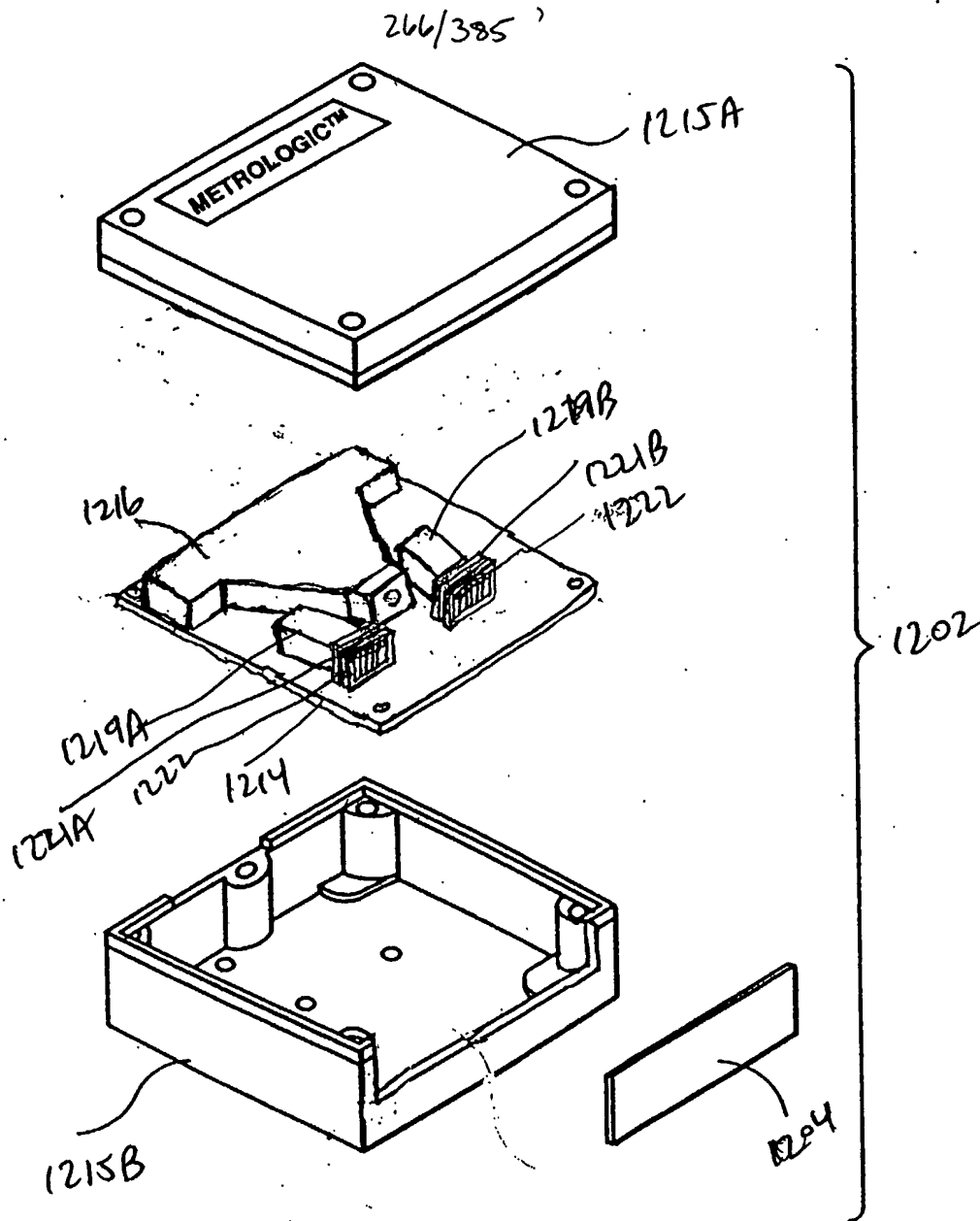


FIG. 39B

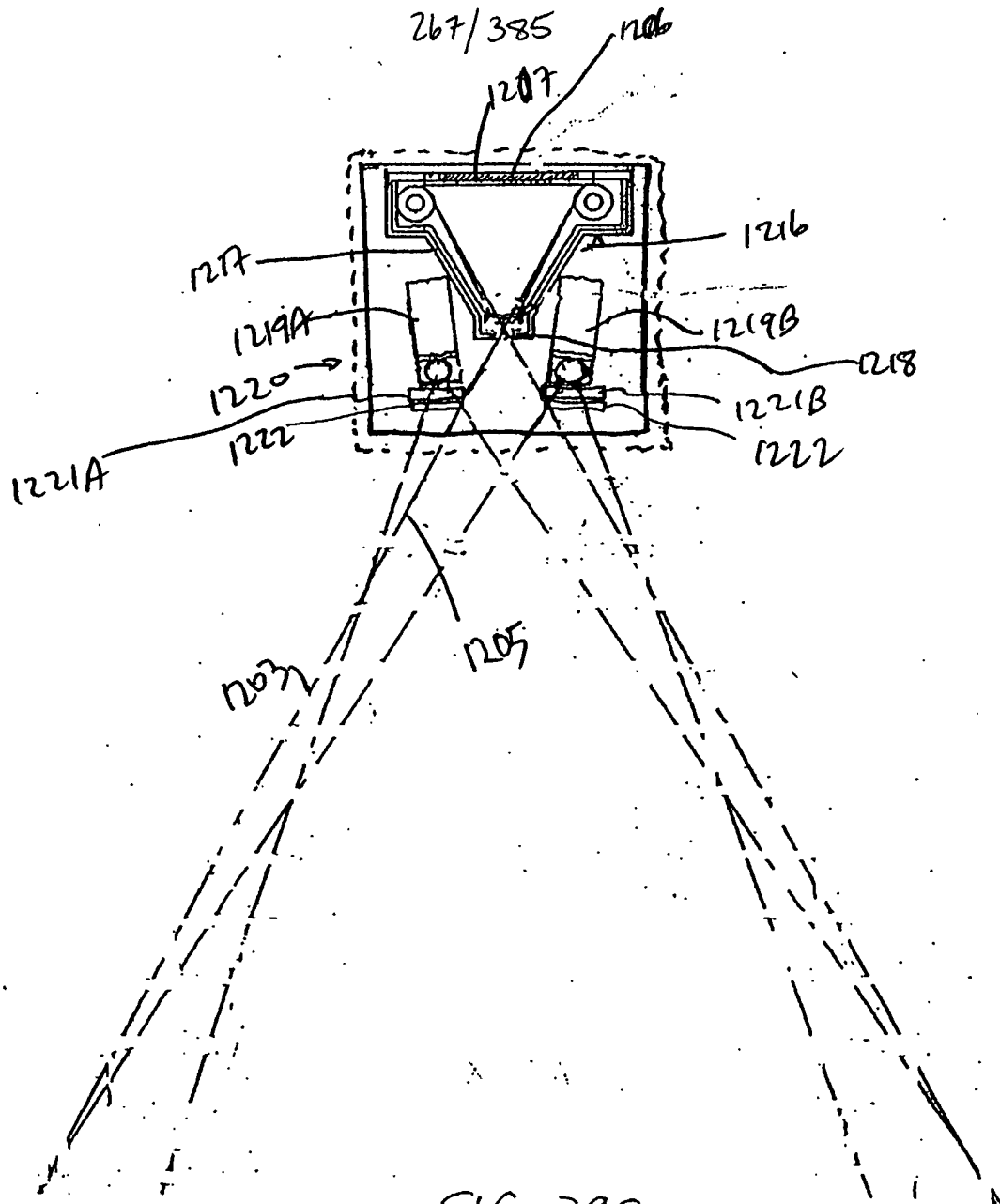


FIG. 39C



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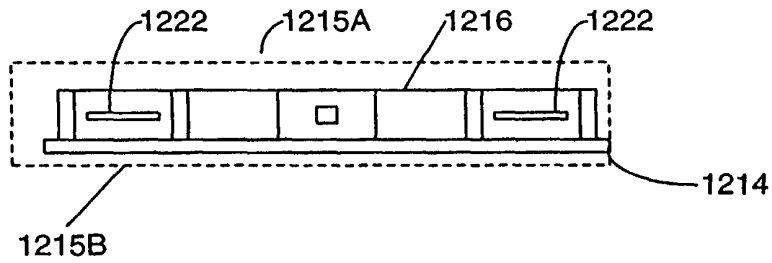


FIG. 39D

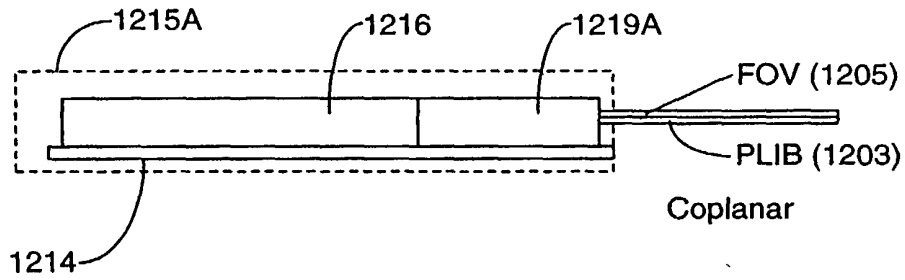


FIG. 39E

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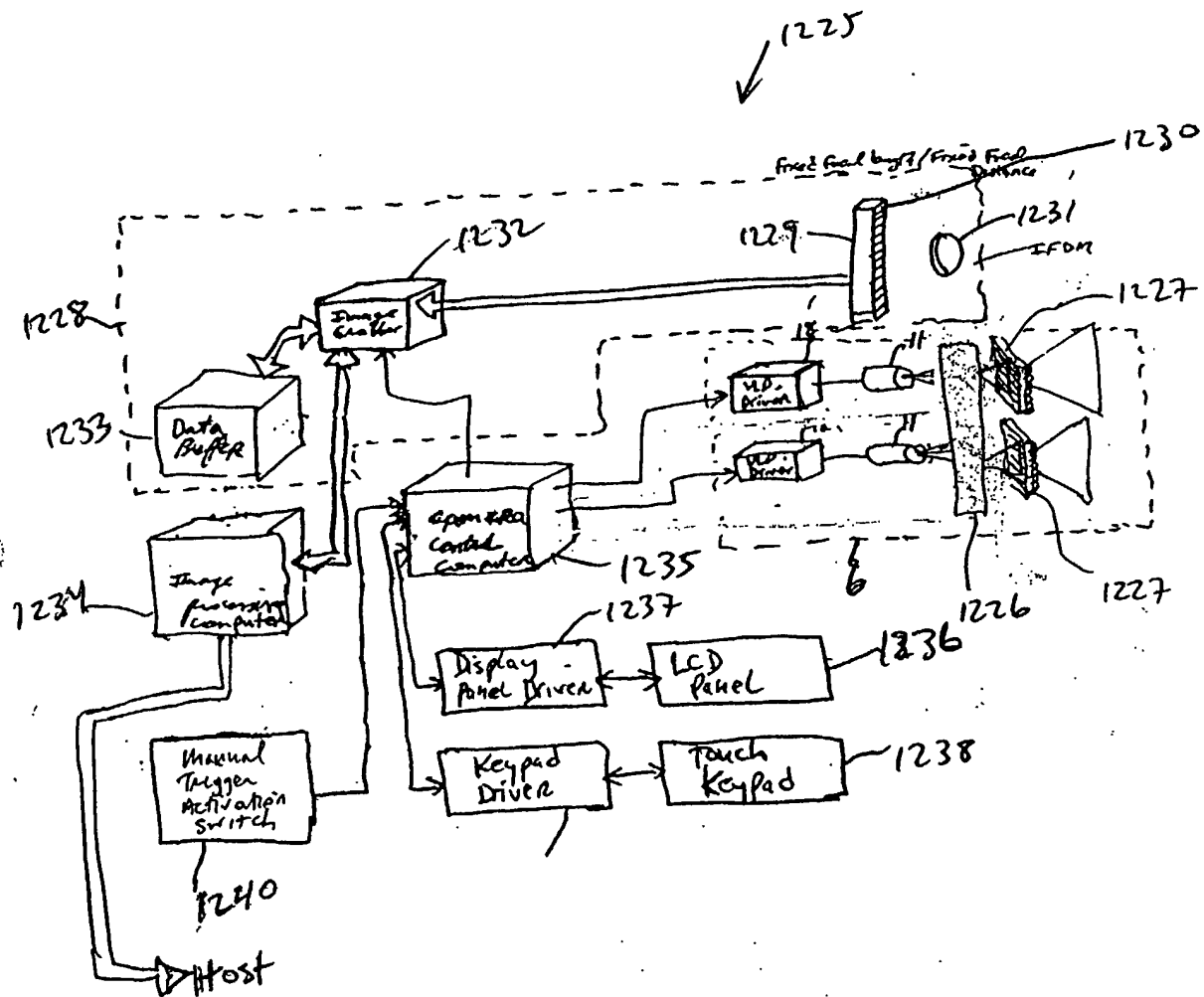
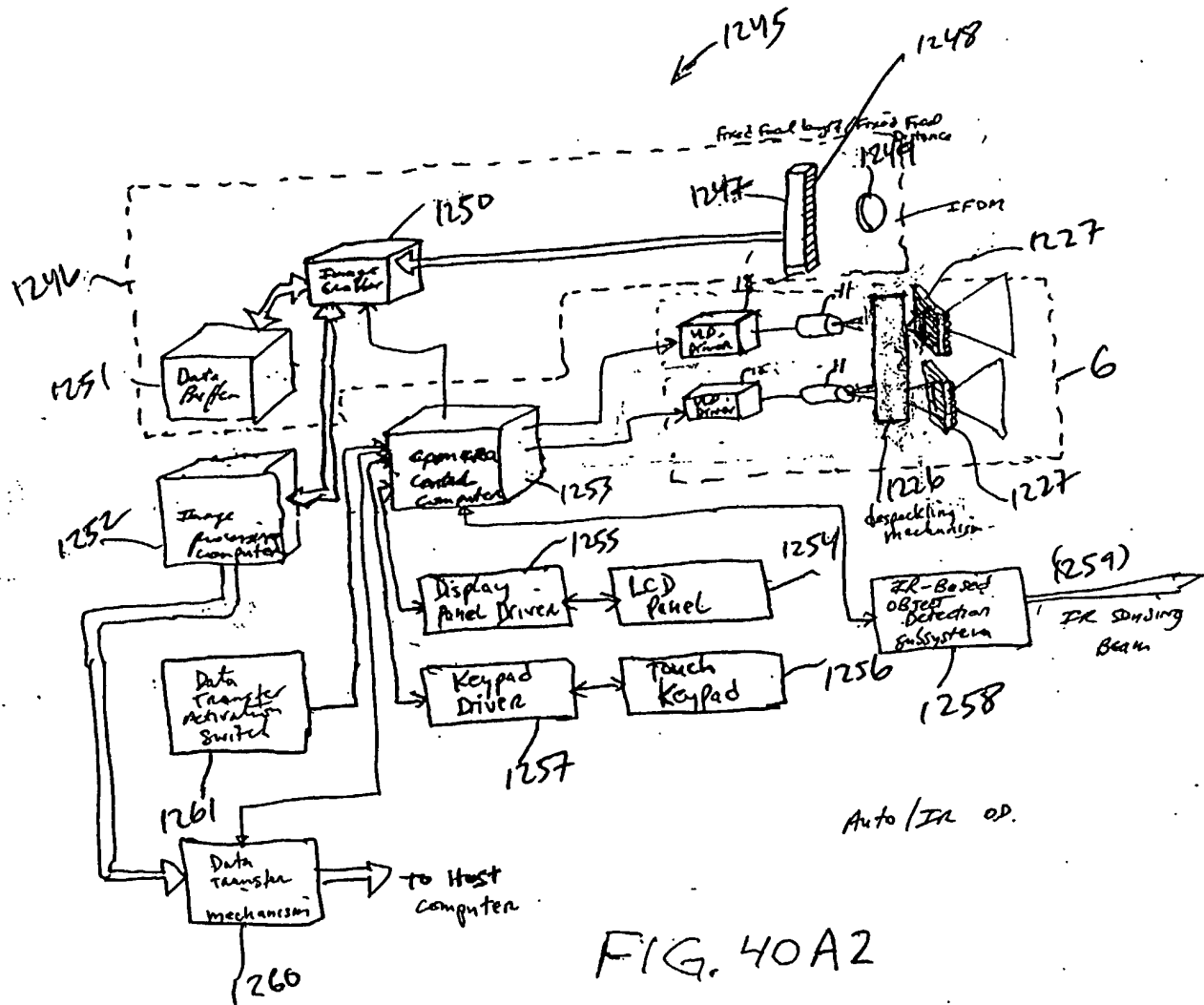
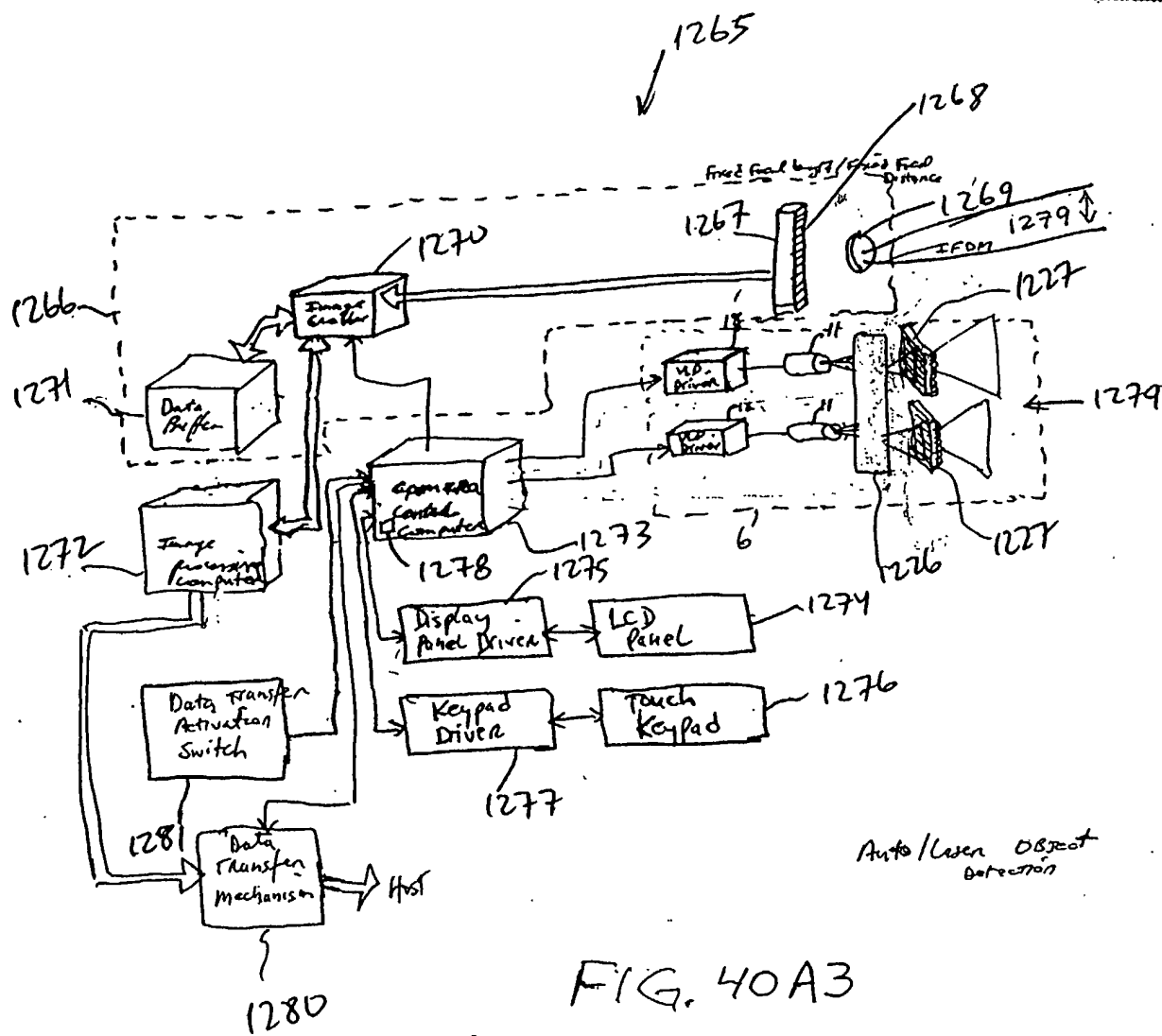


FIG. 40A1

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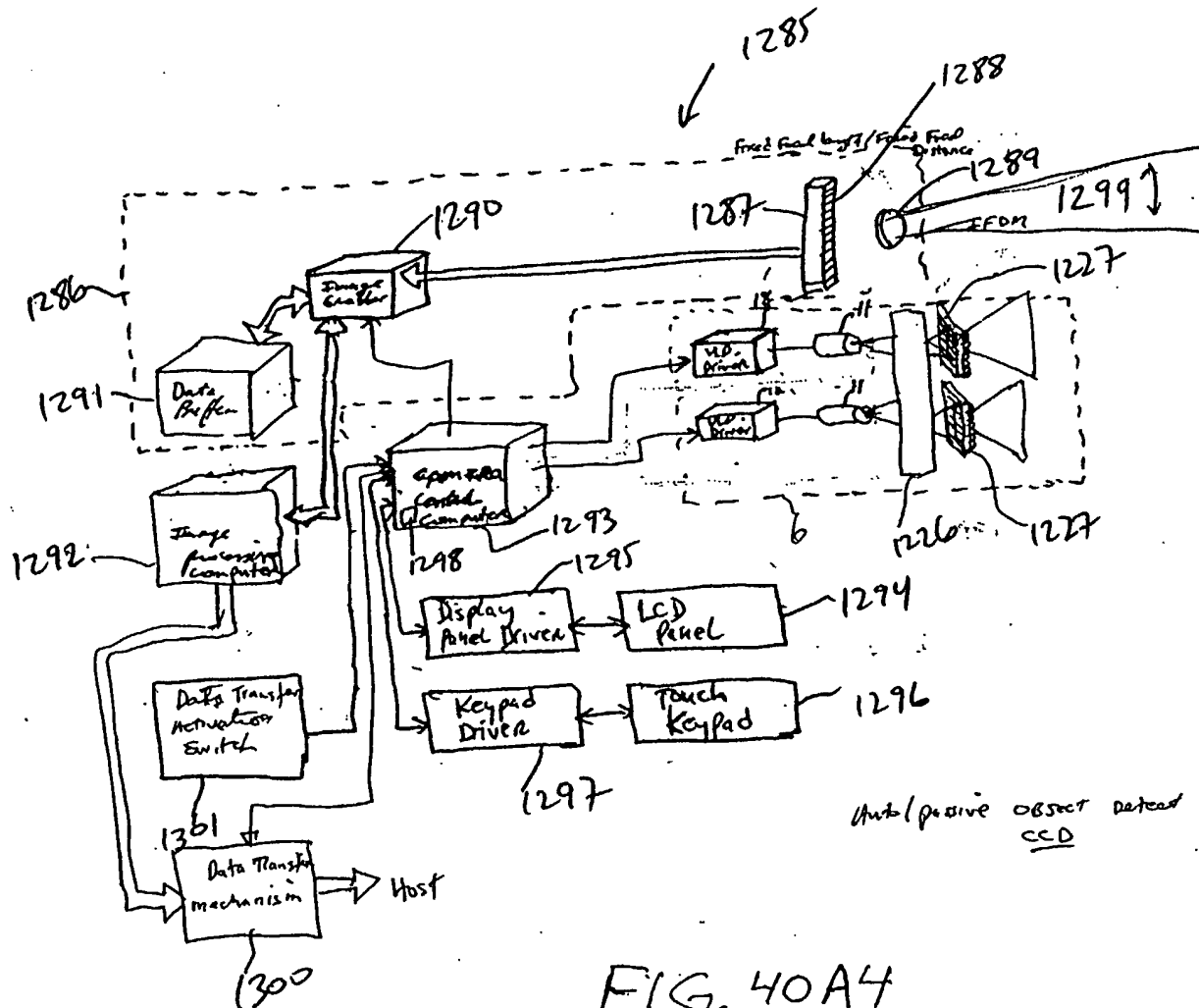
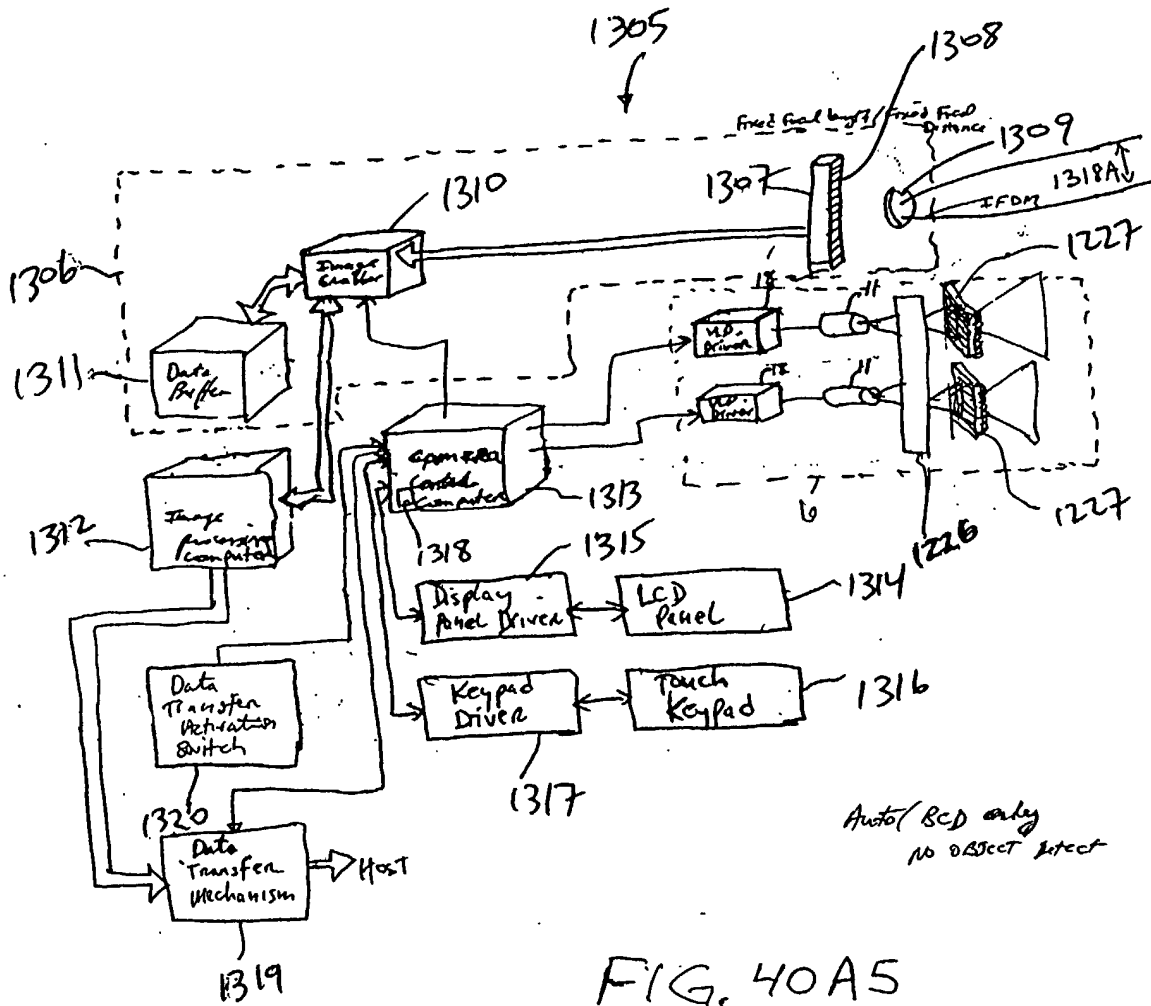


FIG. 40A4

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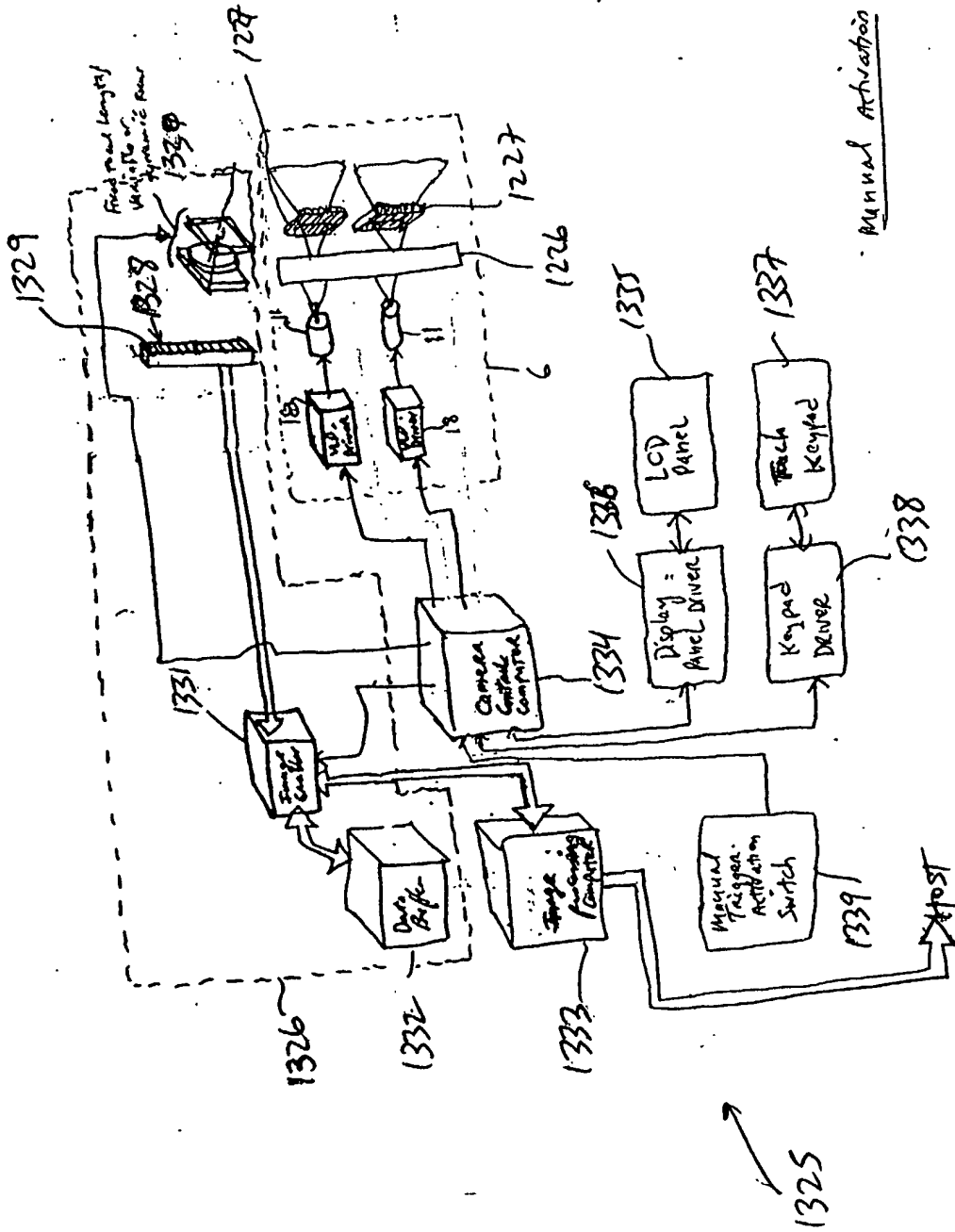


FIG. 40B1

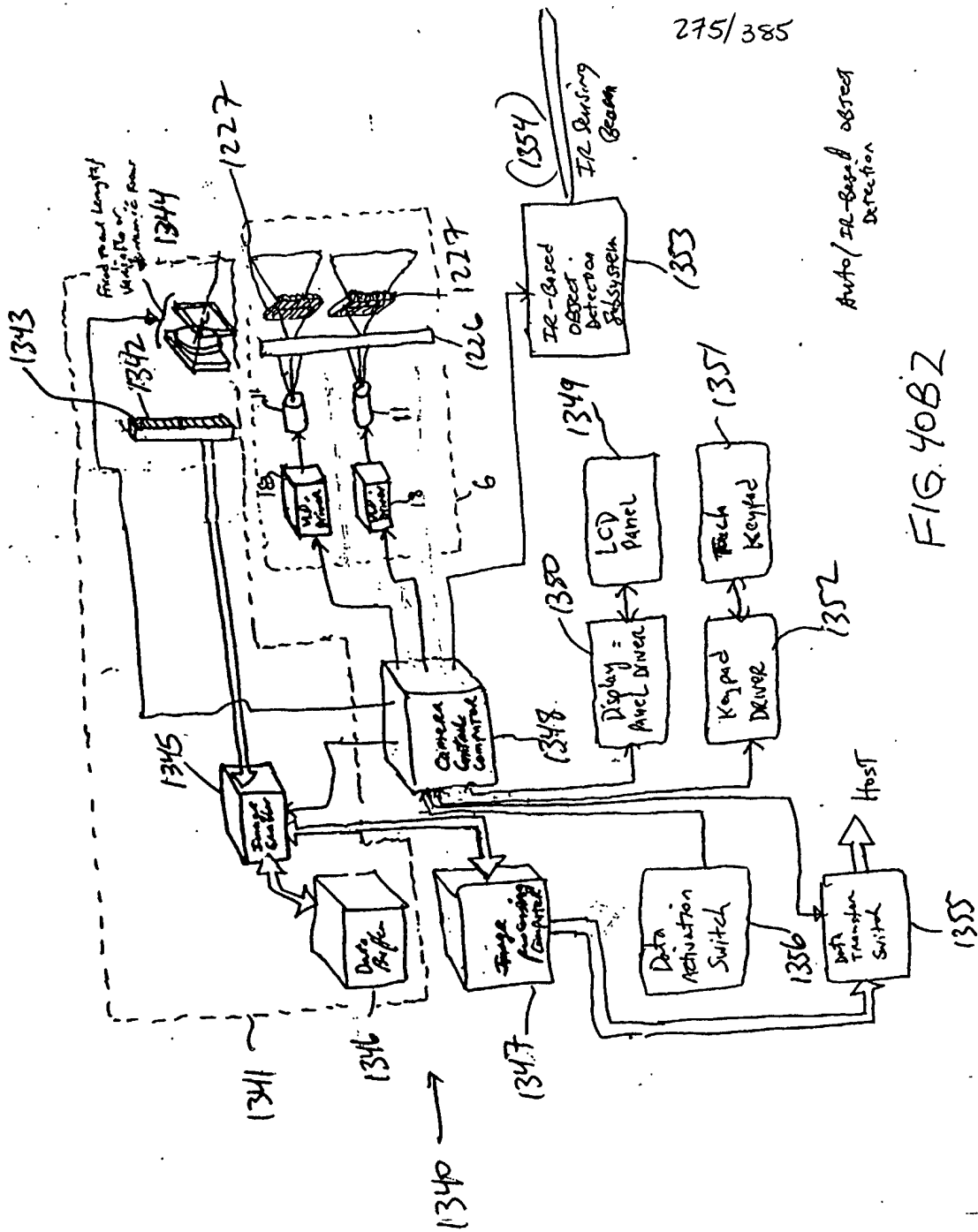
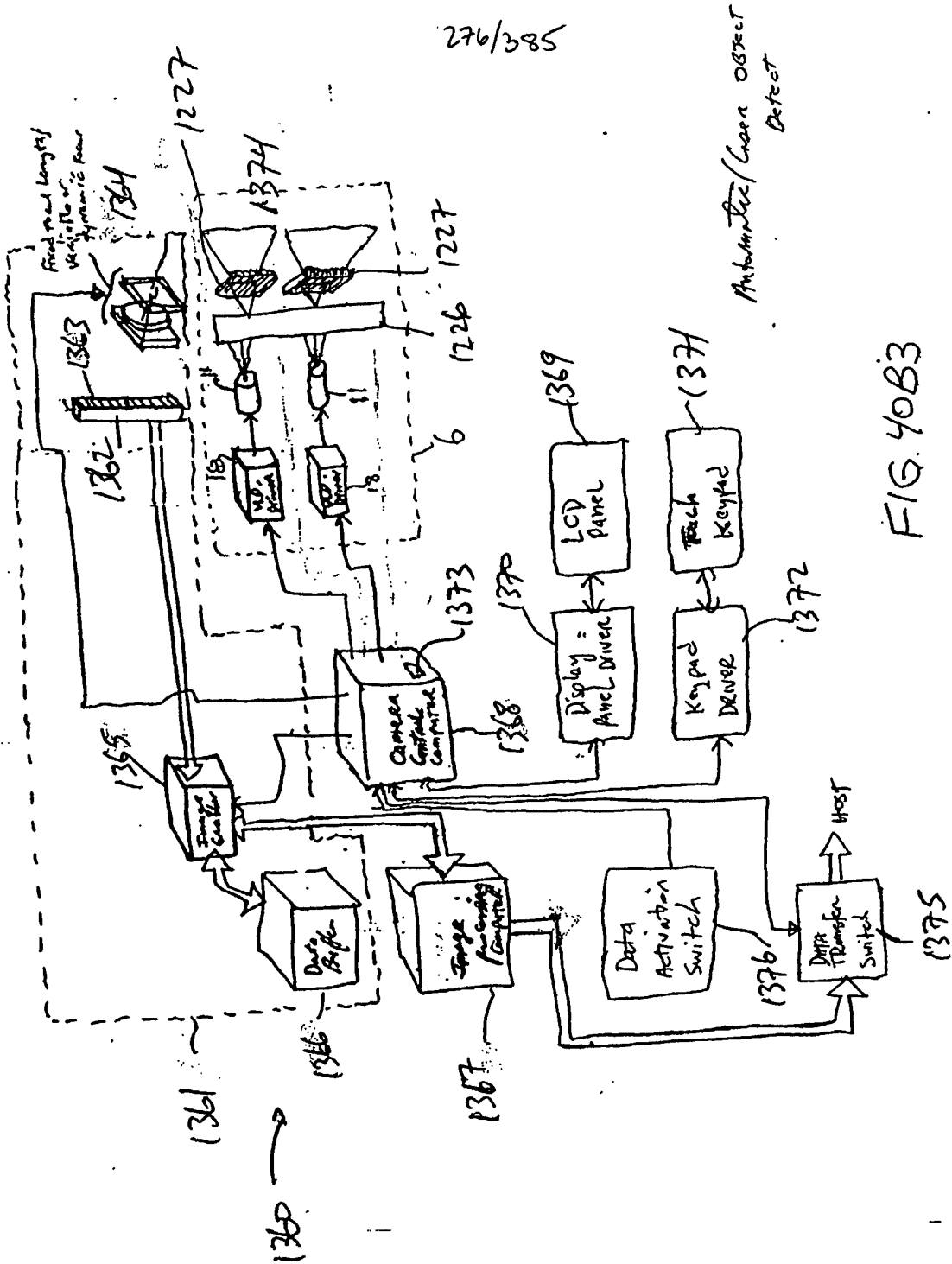


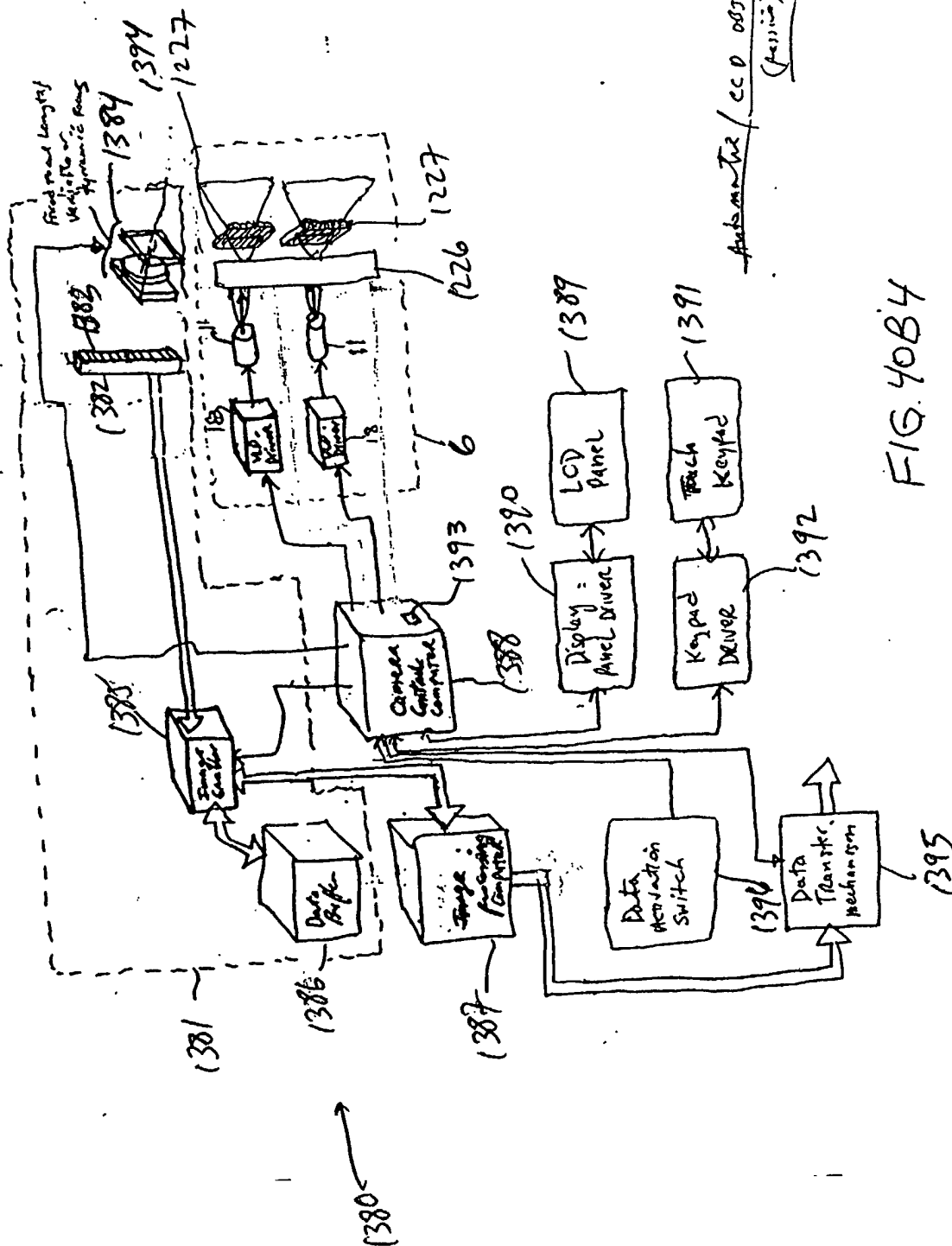
FIG. 40B2





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Autumn / CCO object sheet.  
(passive)



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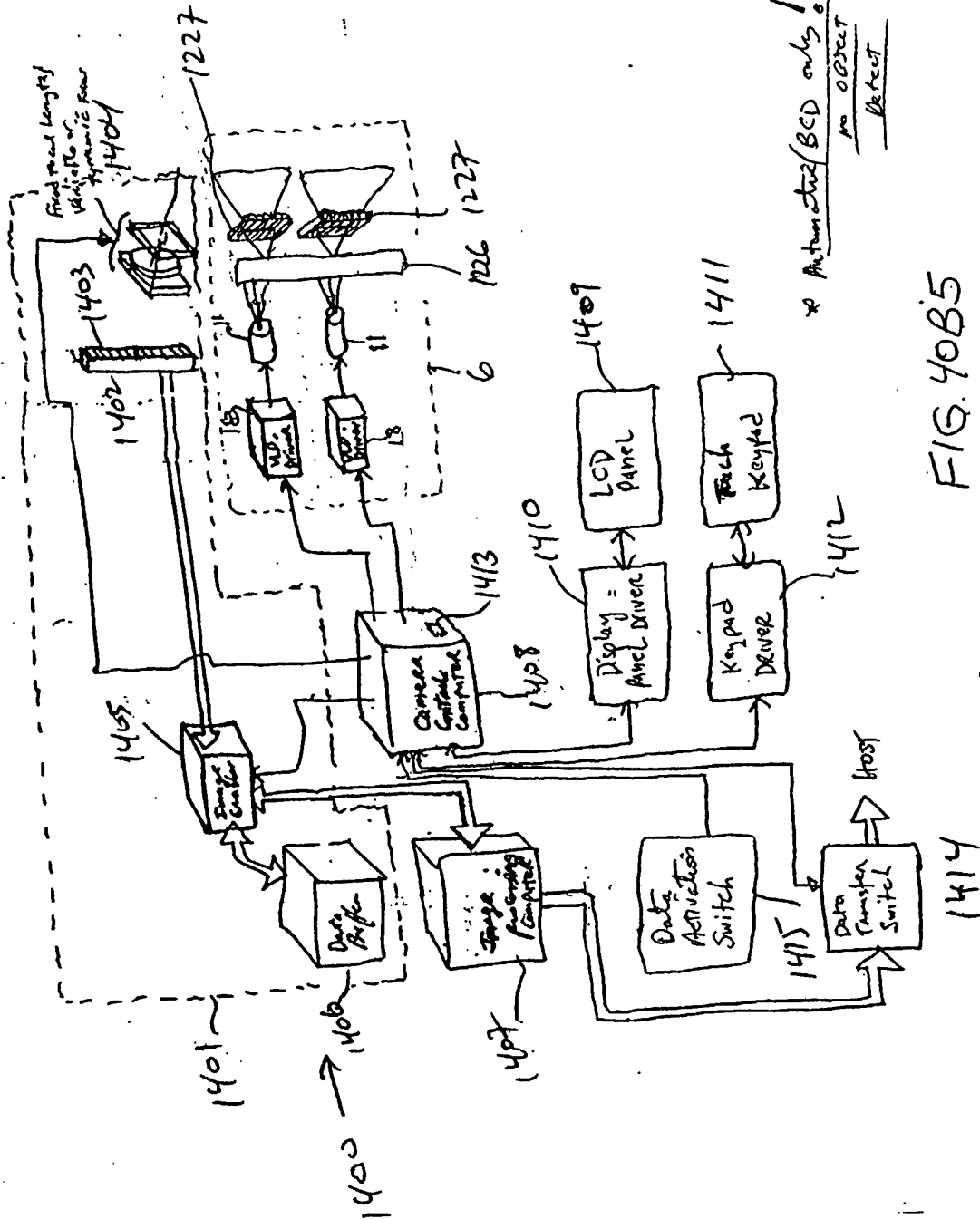
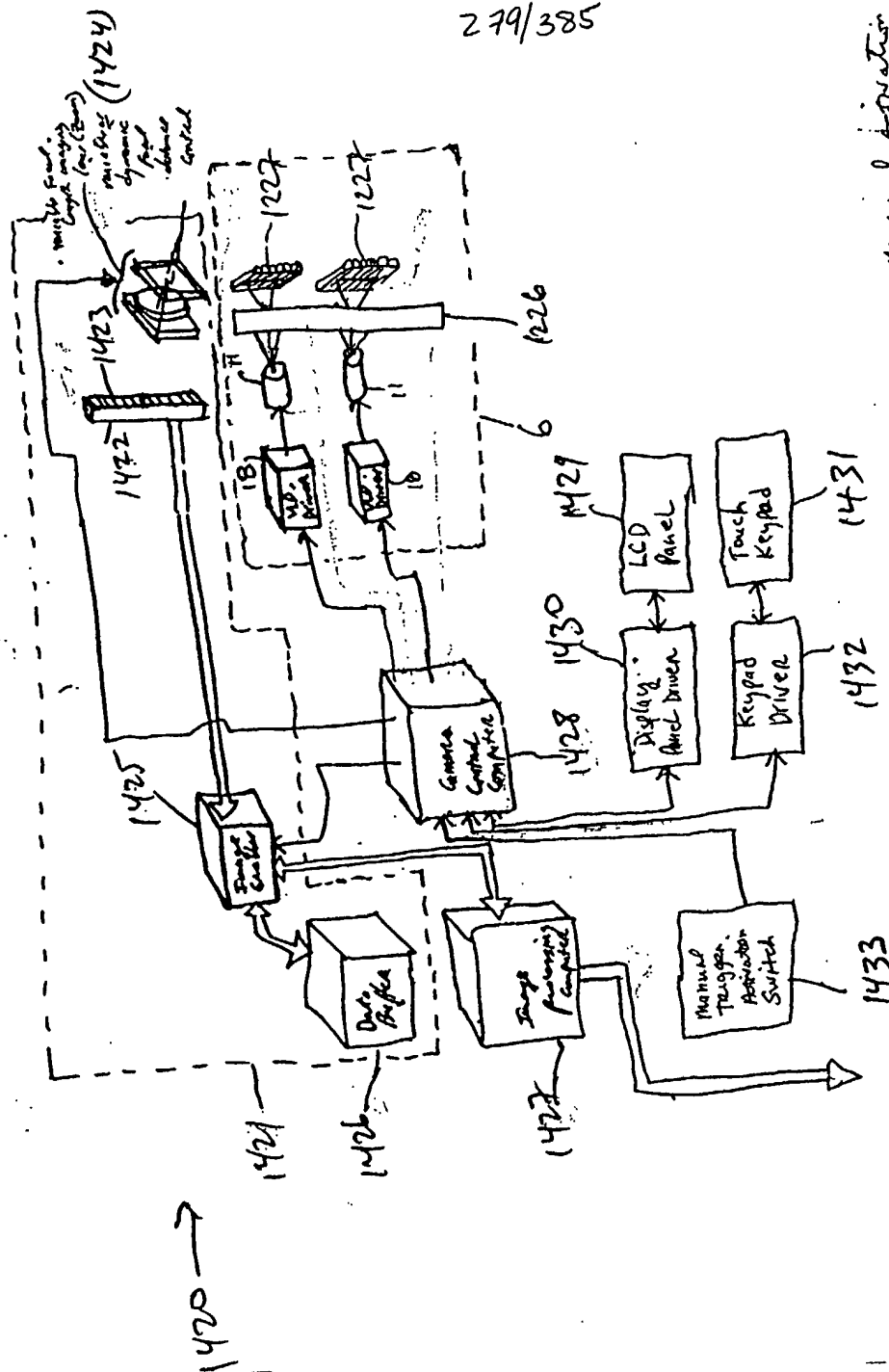


FIG. 40B5

\* Automation/BCD only  
no object  
Detect



Maximal activation

FIG. 40C1

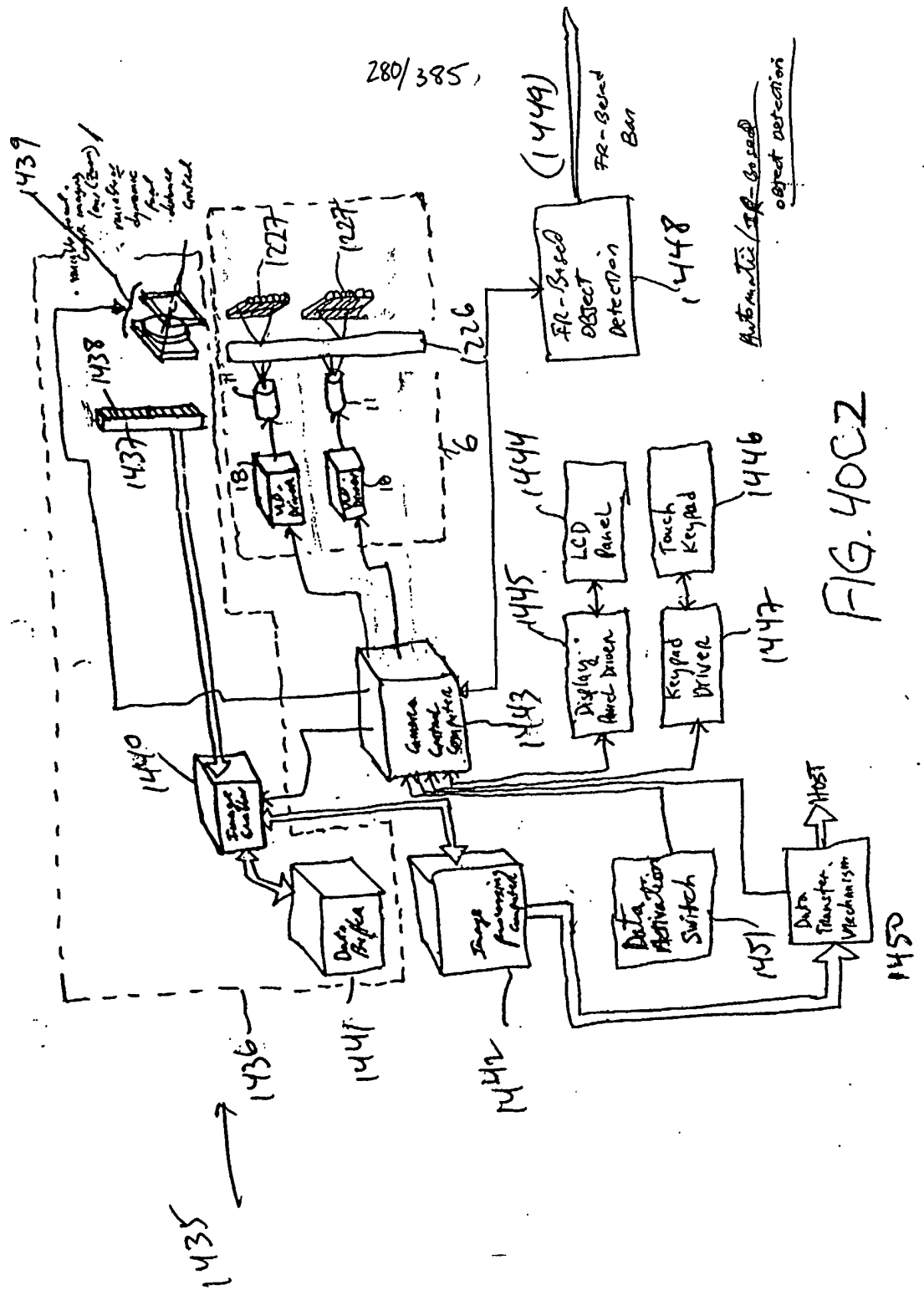
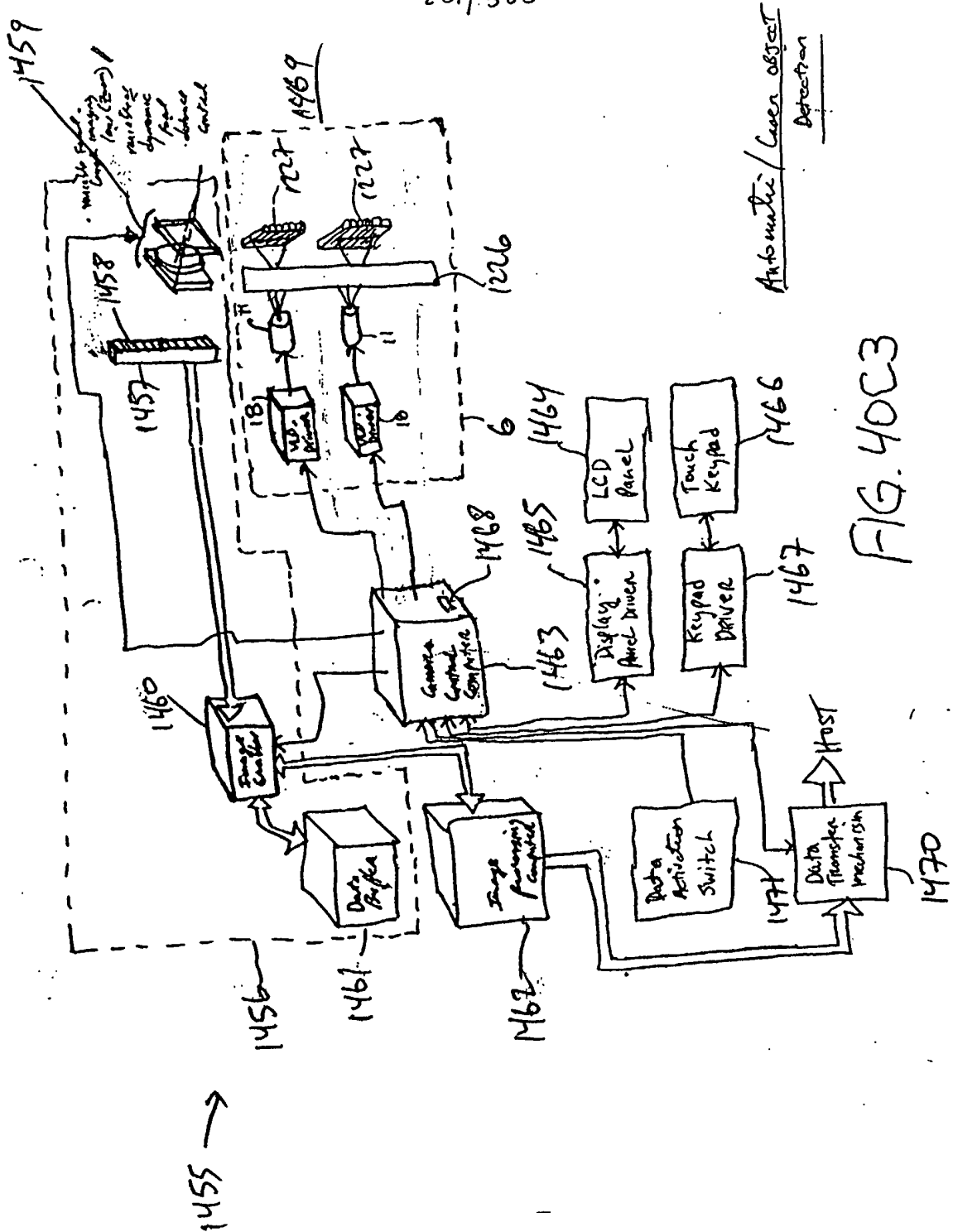


FIG. 40C2



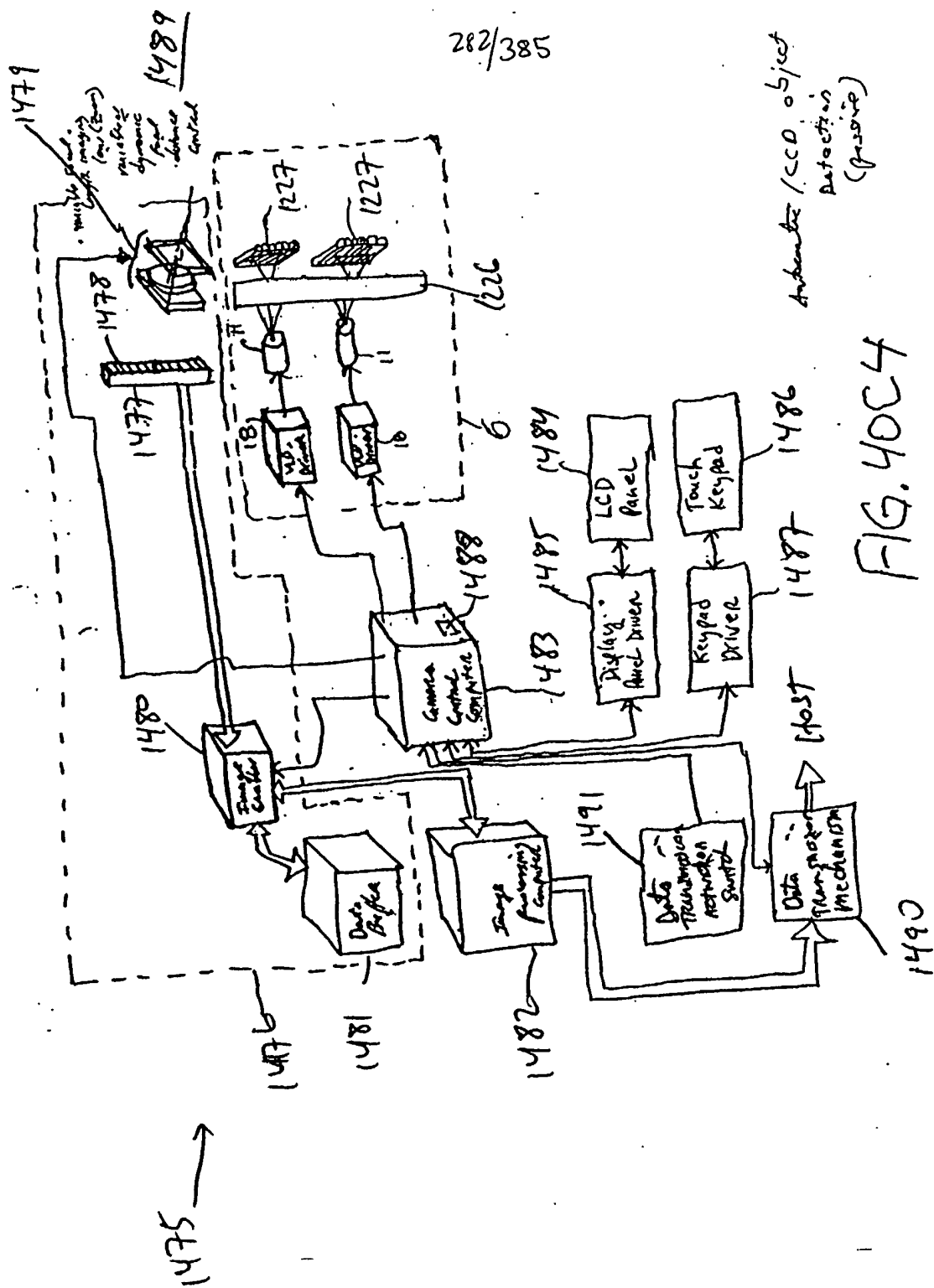
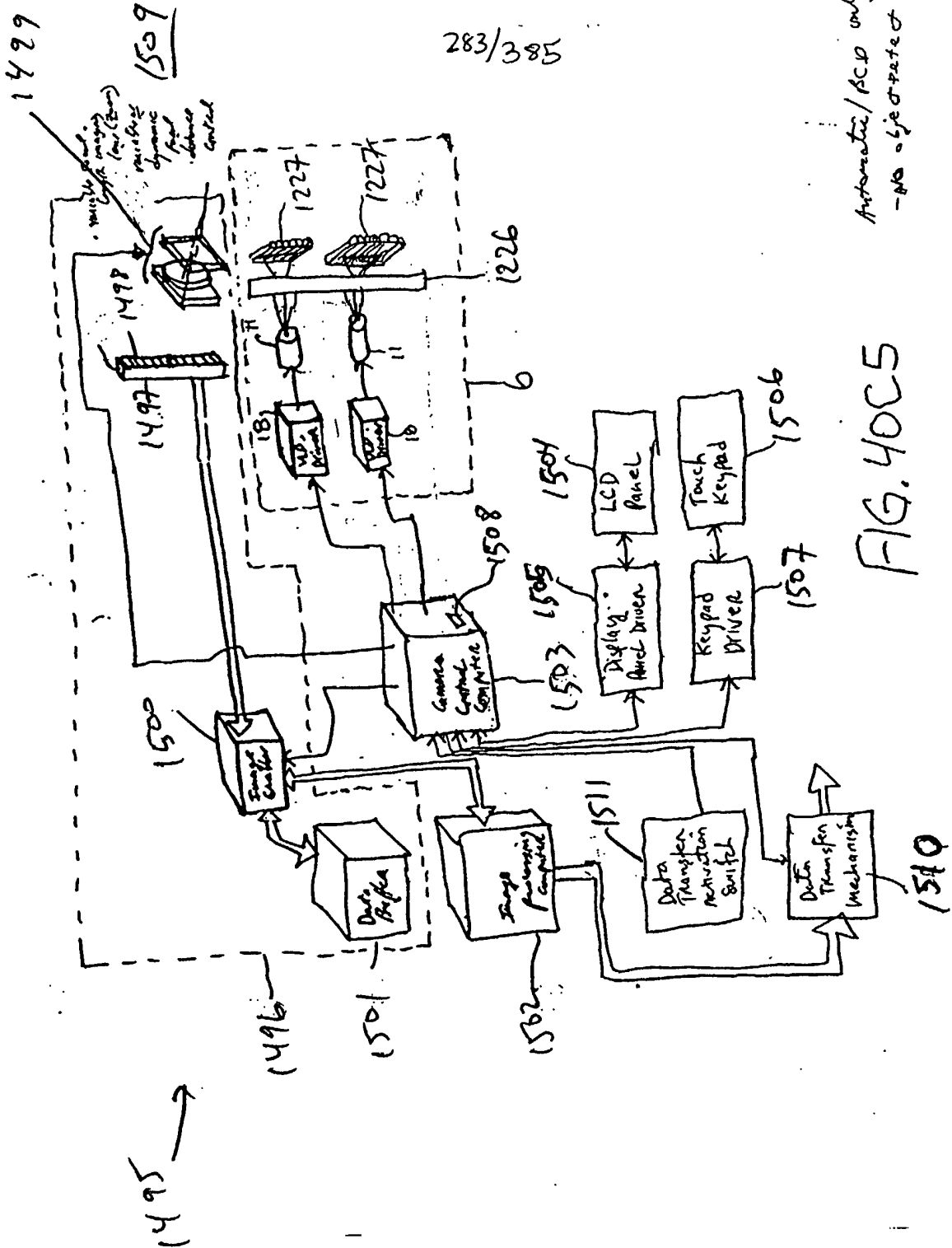


FIG. 40C4

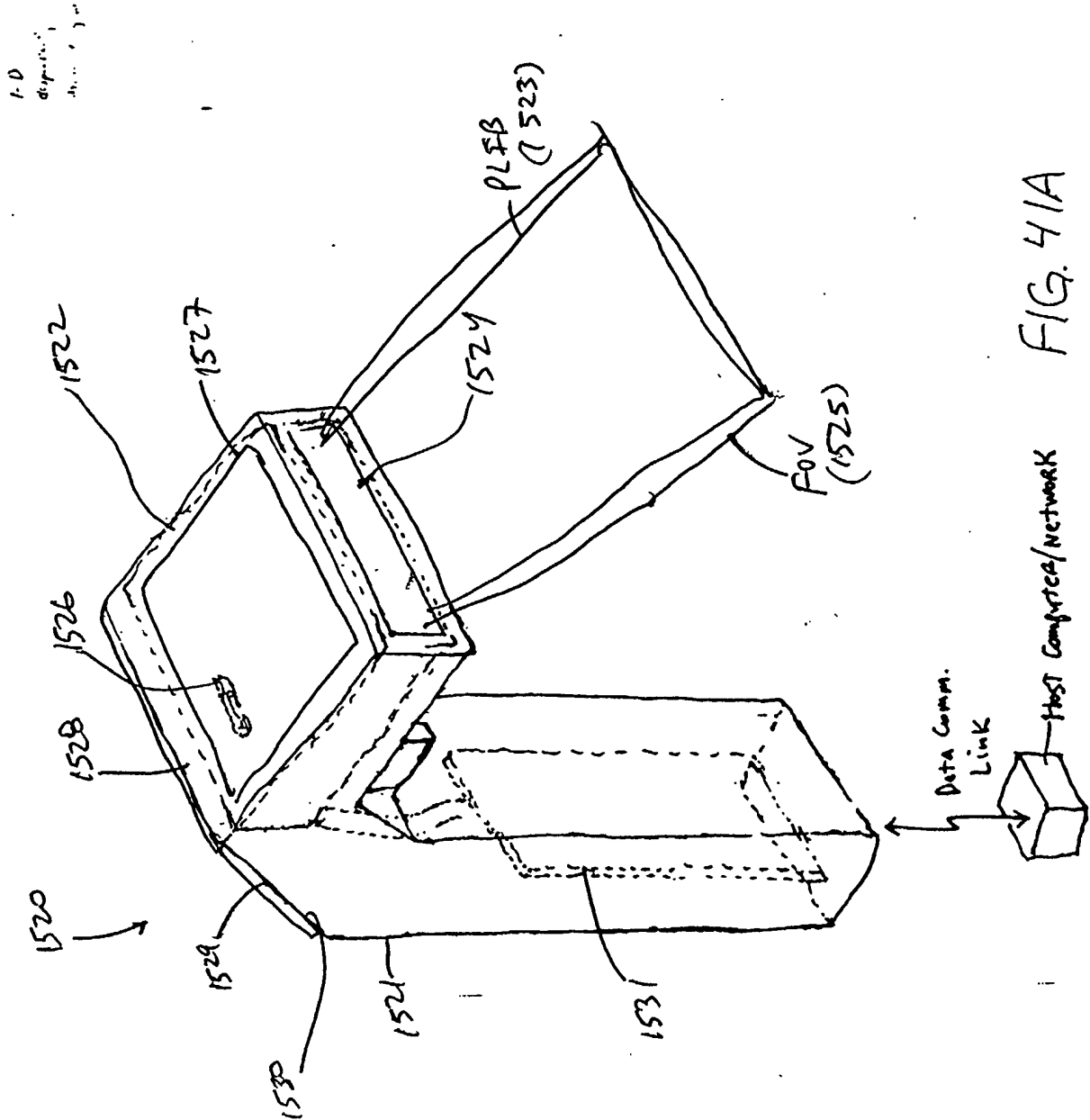
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Autotrophic/SCP only  
-No objection





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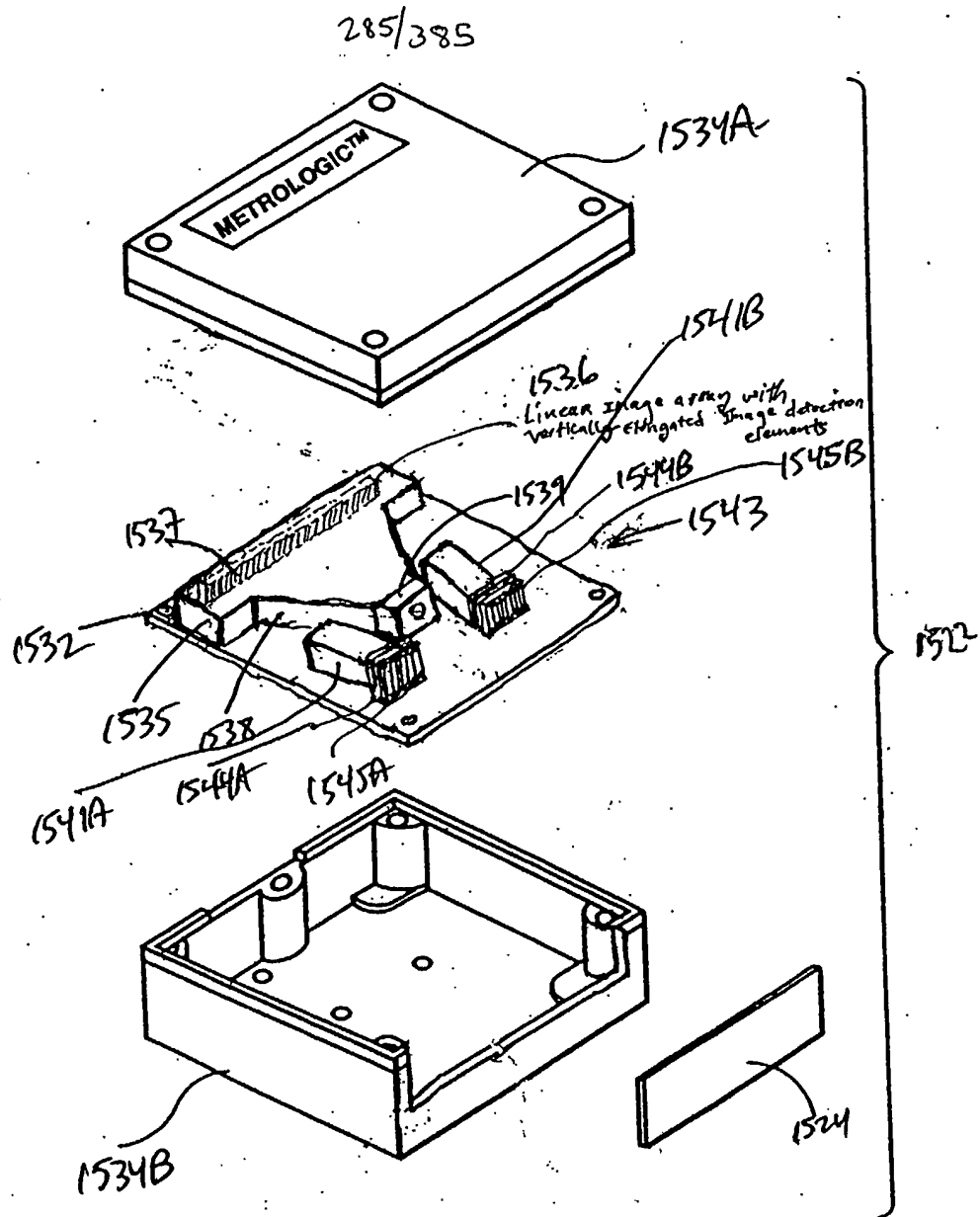


FIG. 41B

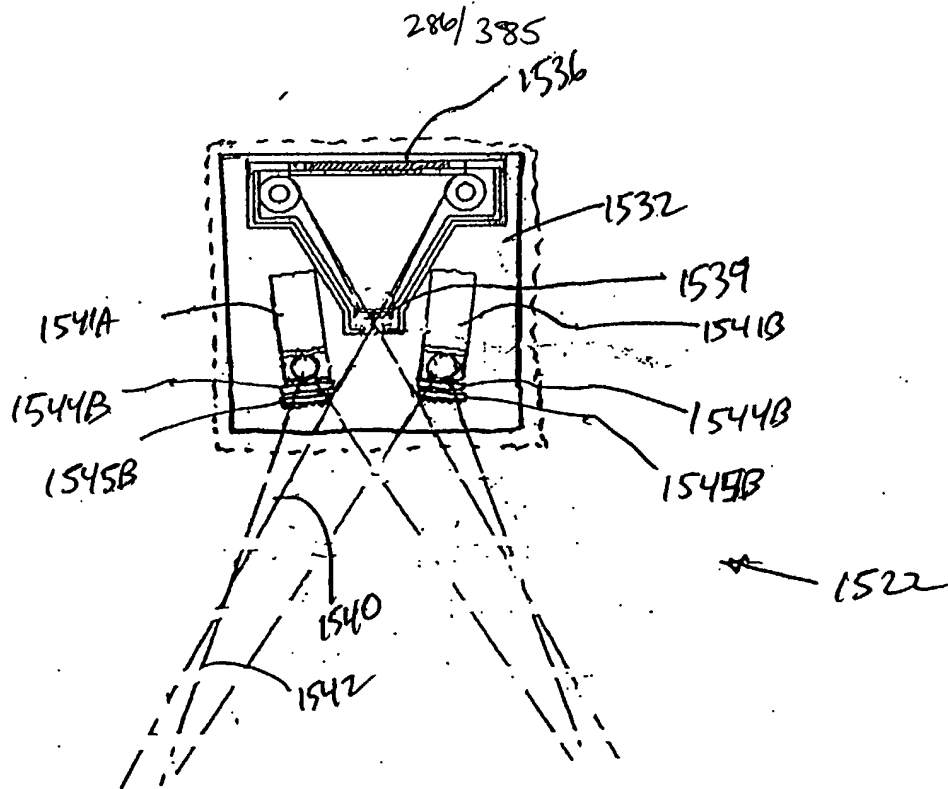


FIG. 41C

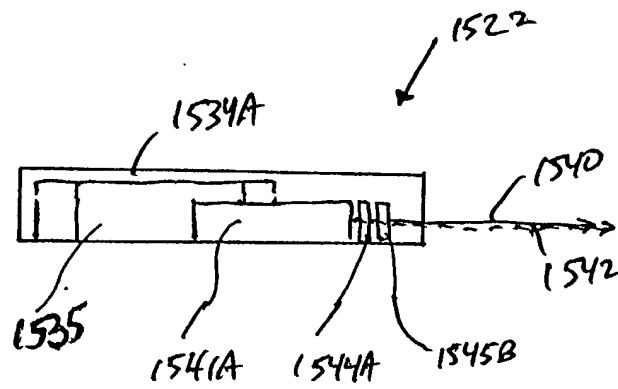
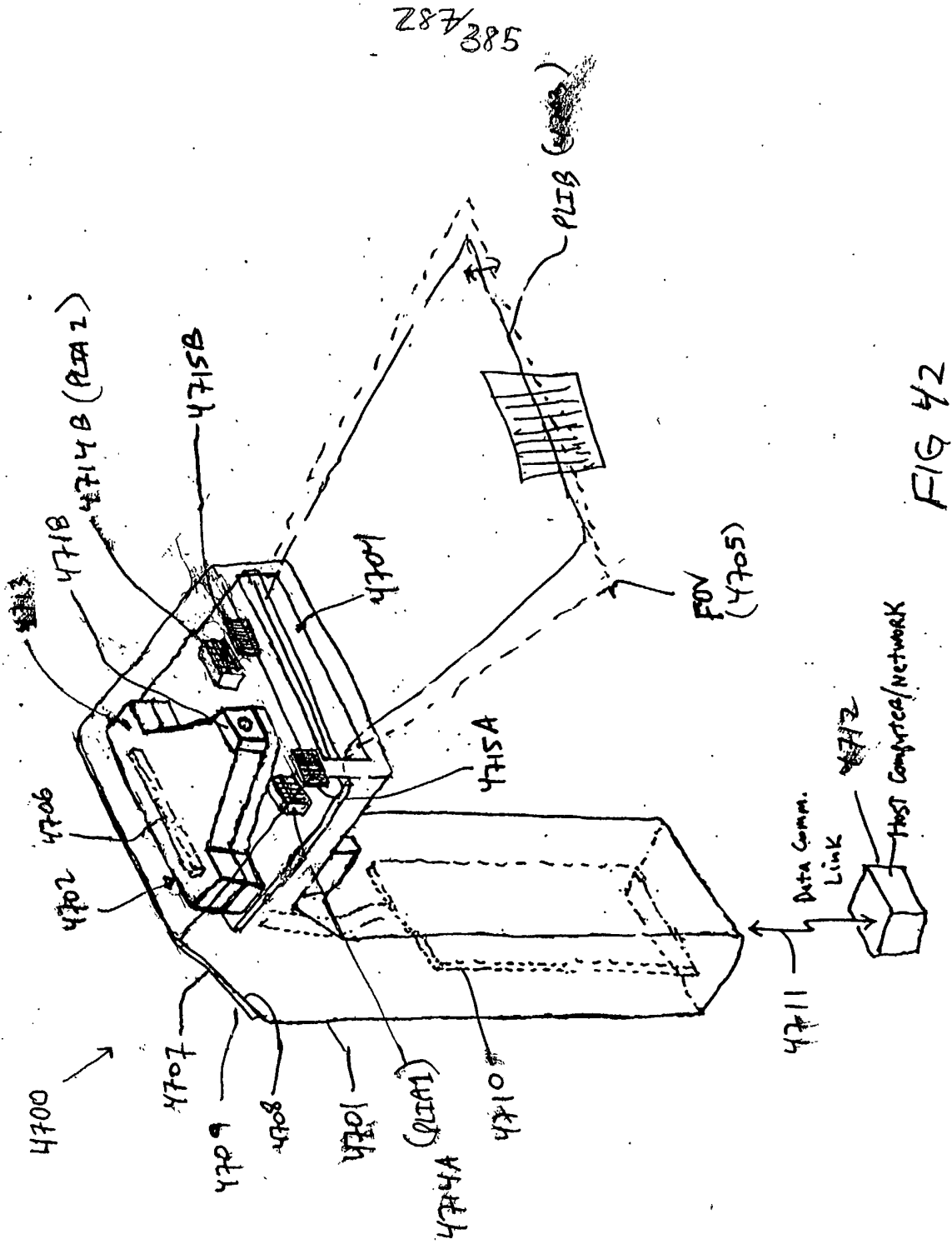


FIG. 41D



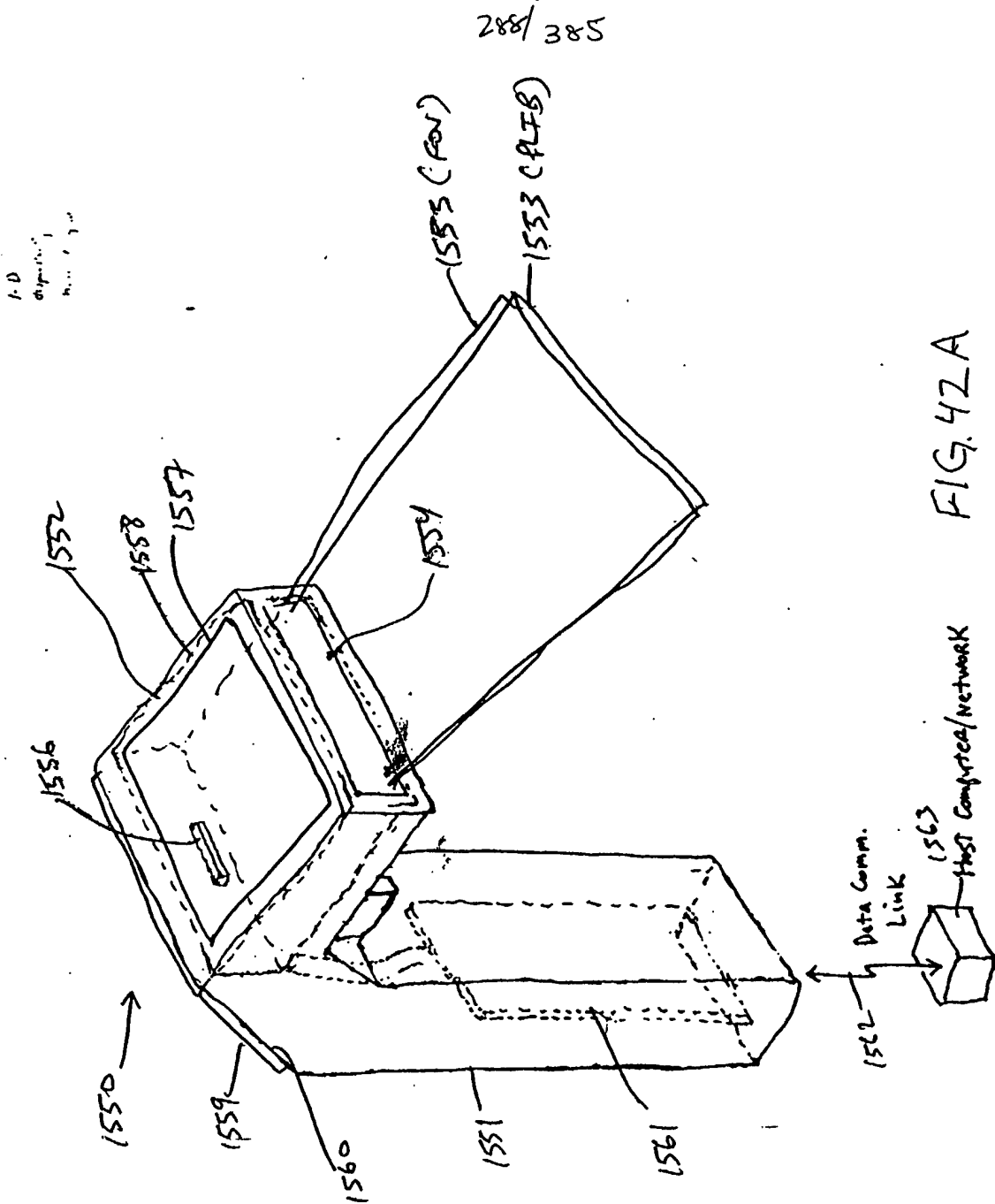


FIG. 42A

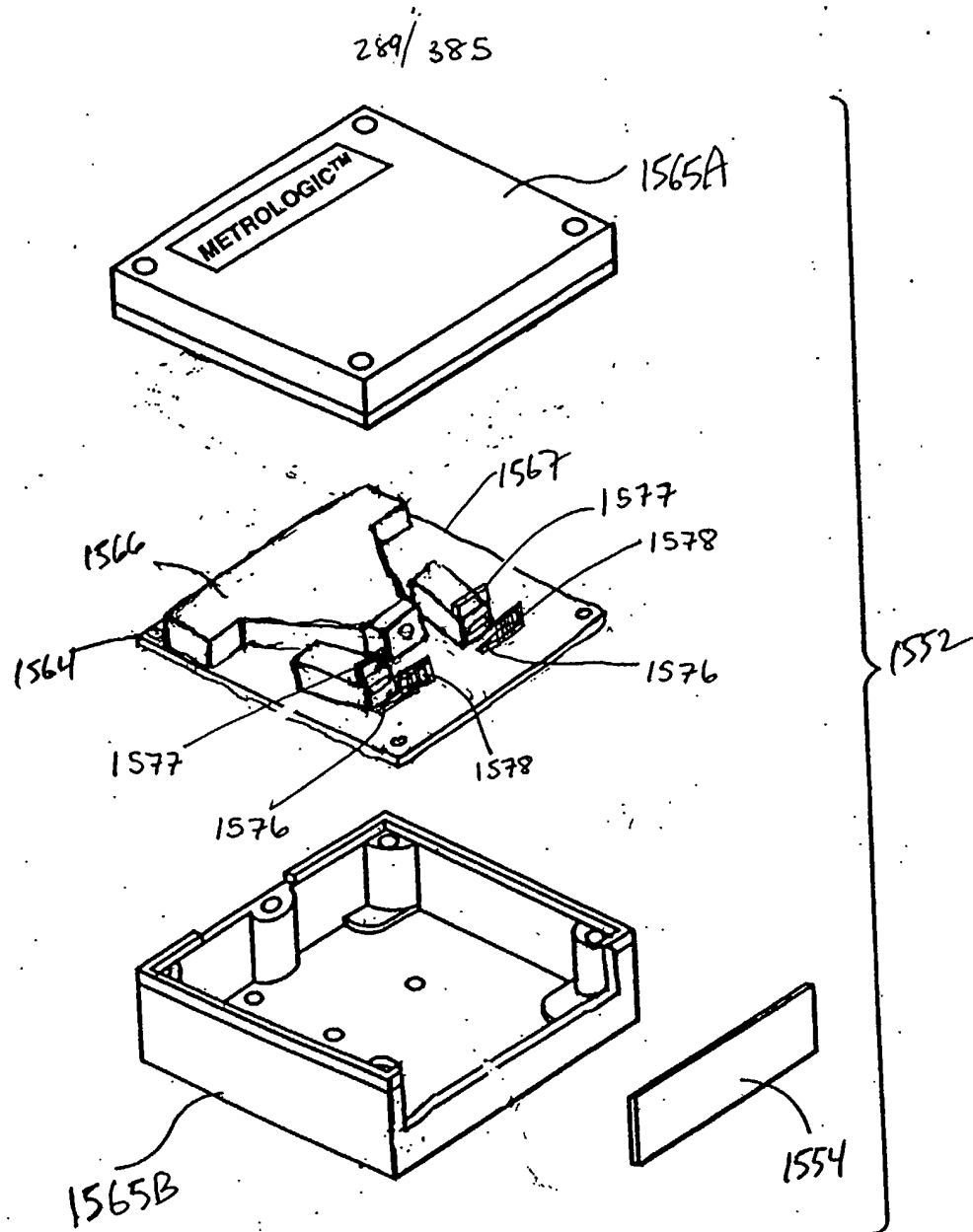


FIG. 42B

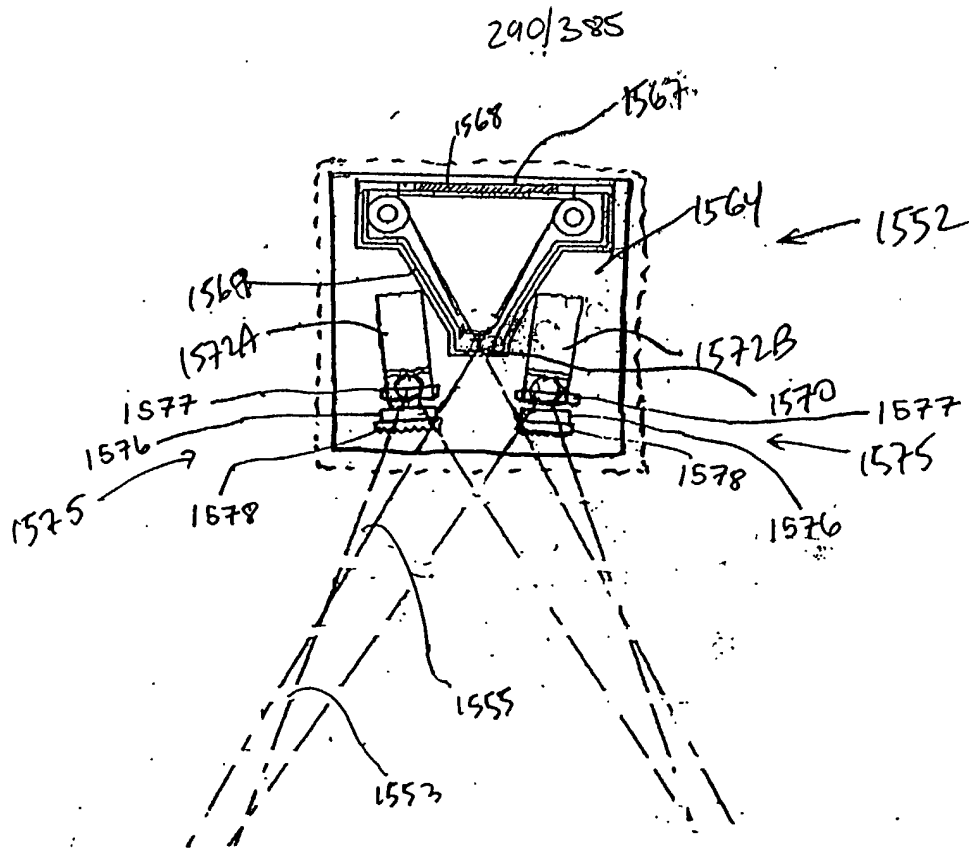


FIG. 42C

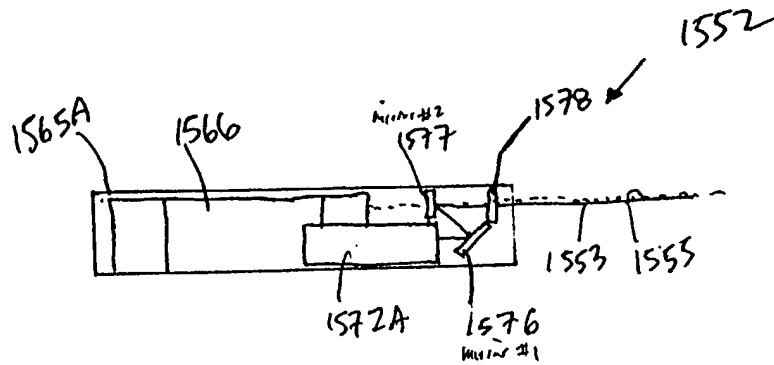


FIG. 42D

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1-D  
display  
Area

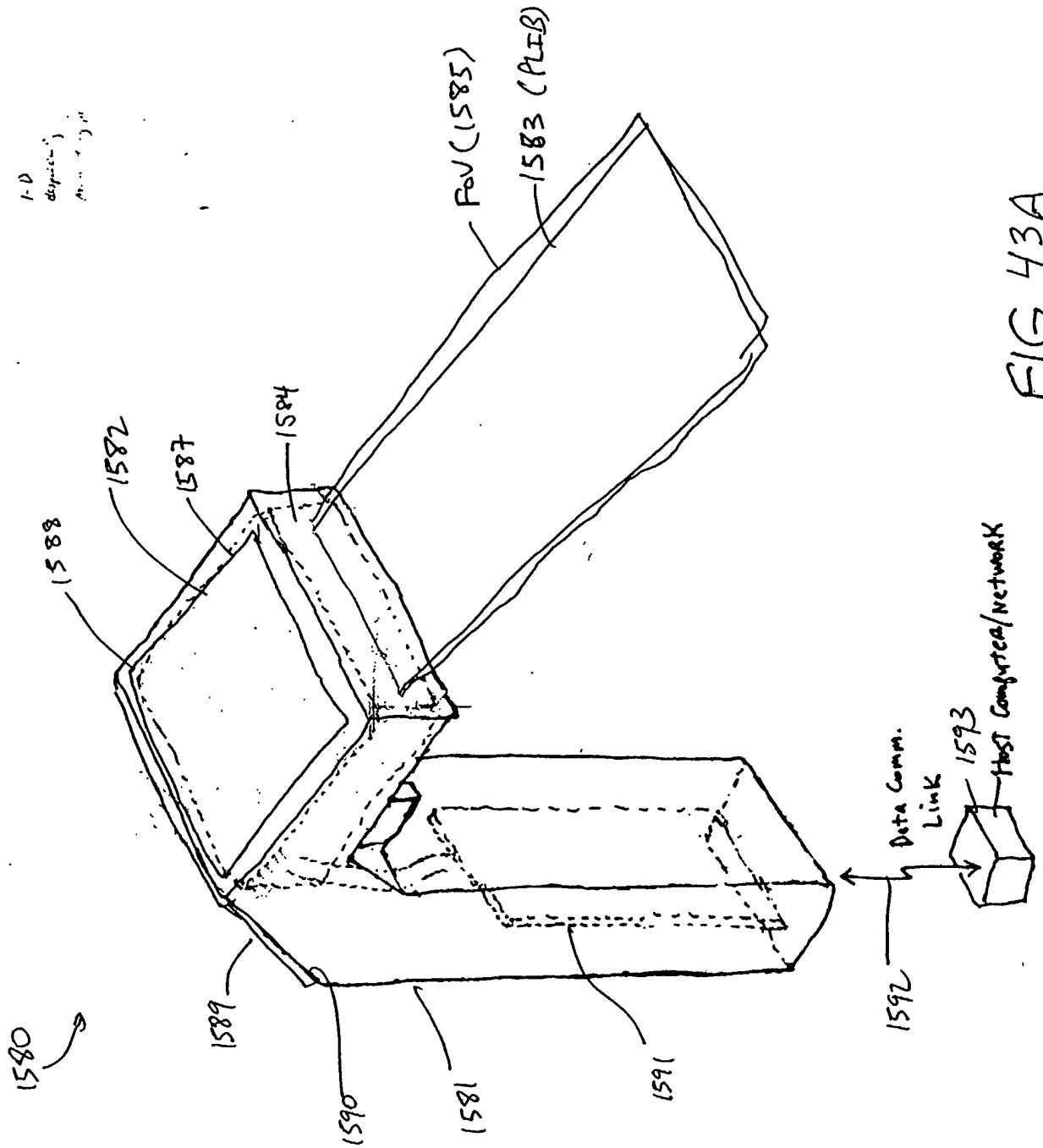


FIG. 43A



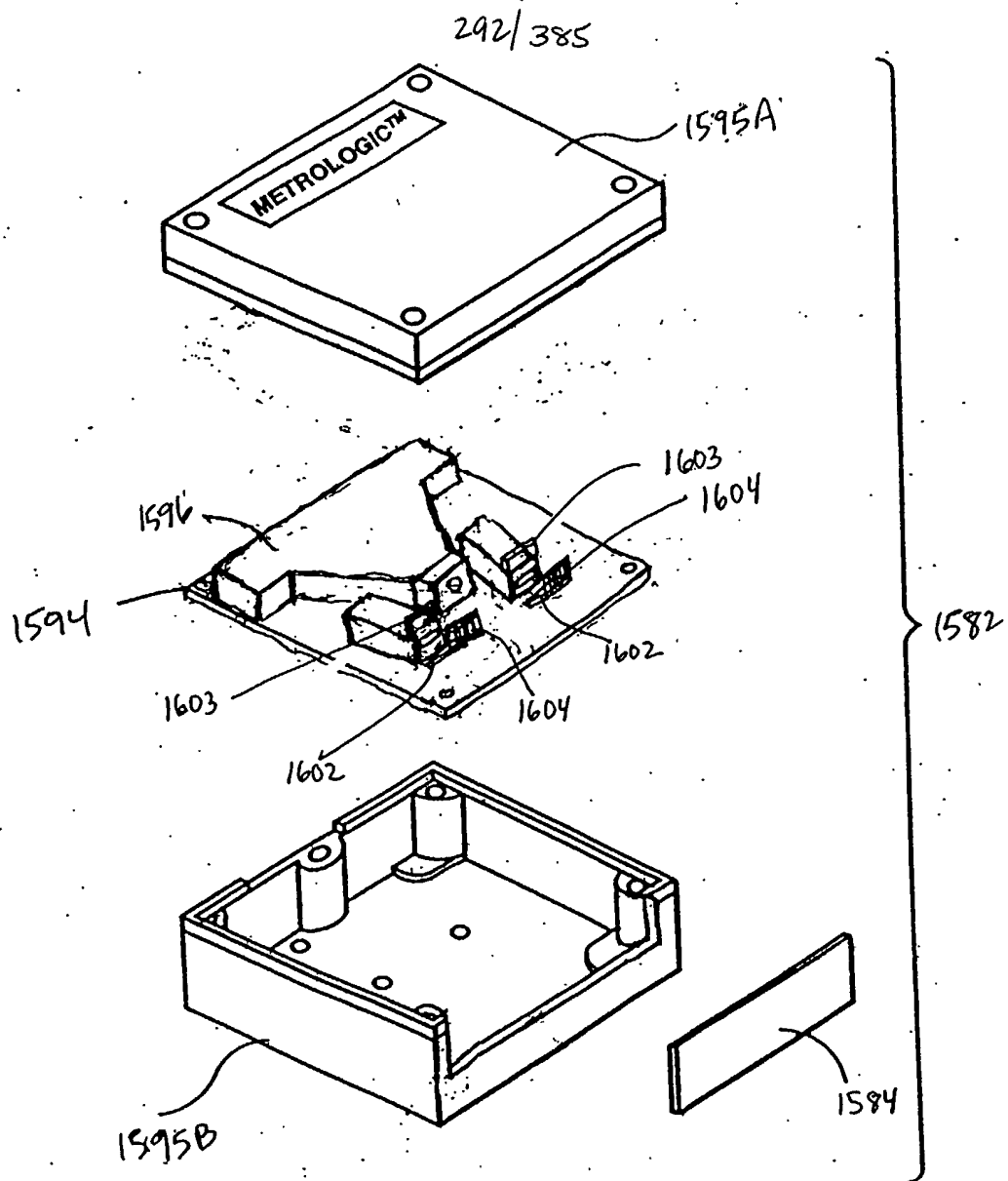


FIG. 43B

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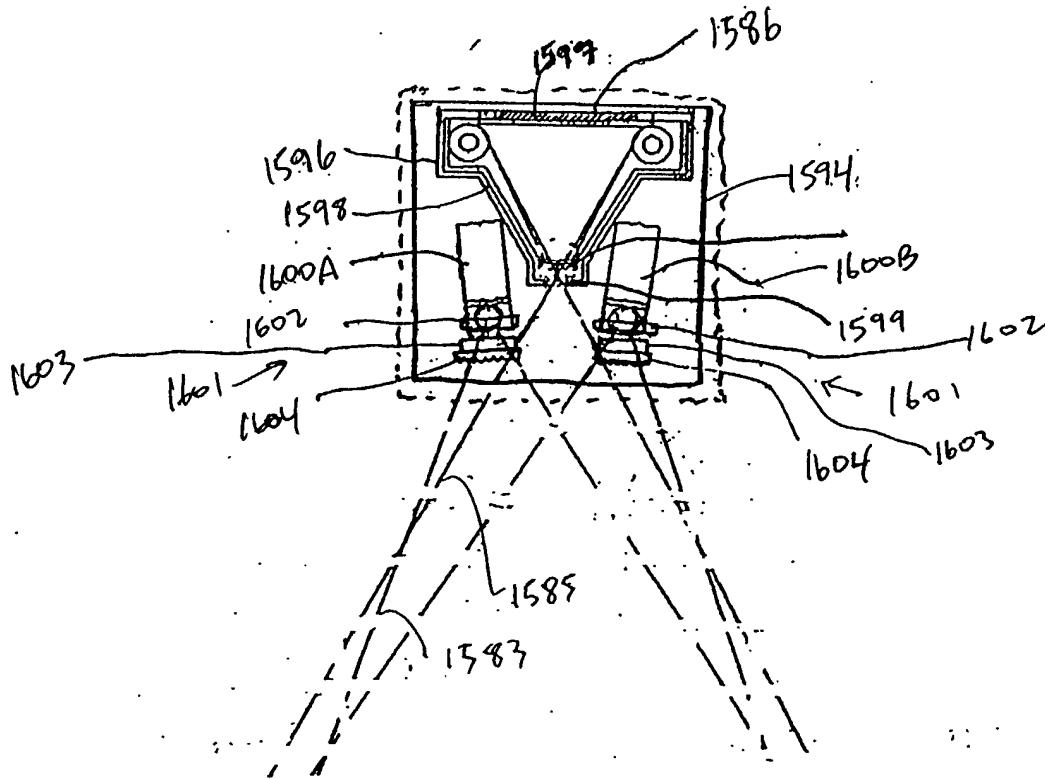


FIG. 43C

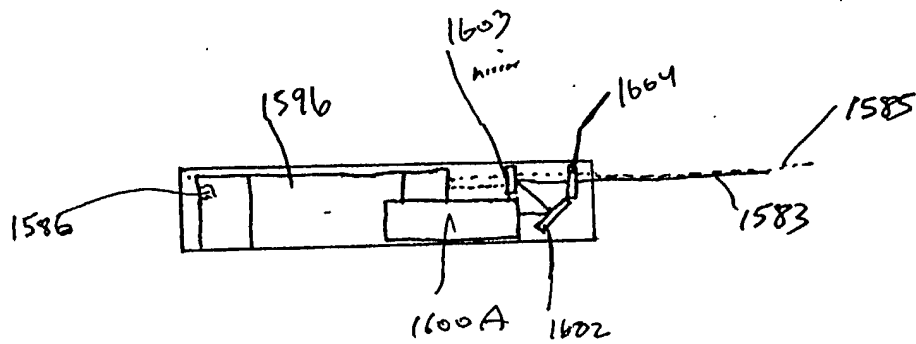


FIG. 43D

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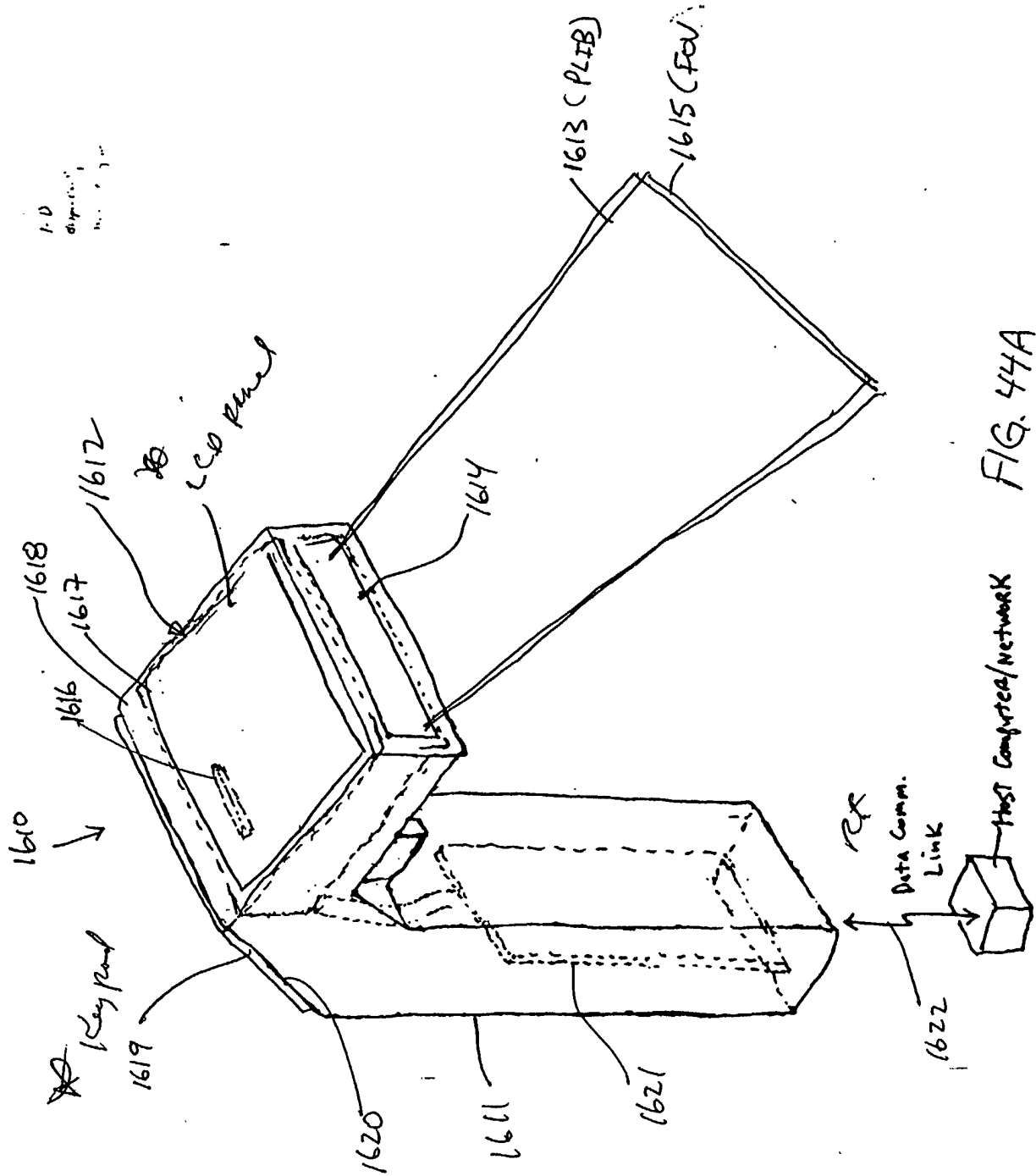


FIG. 44A

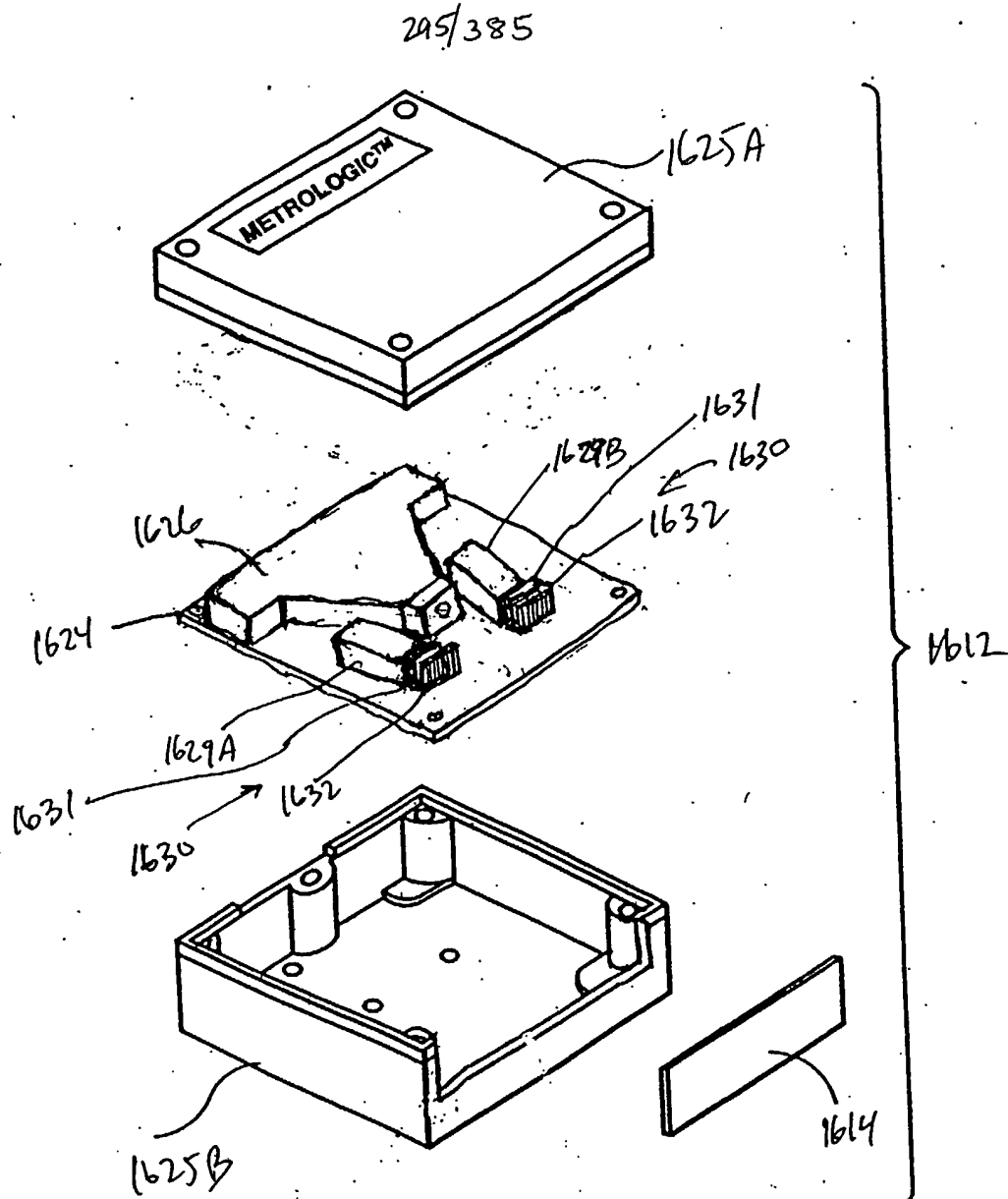


FIG. 44B

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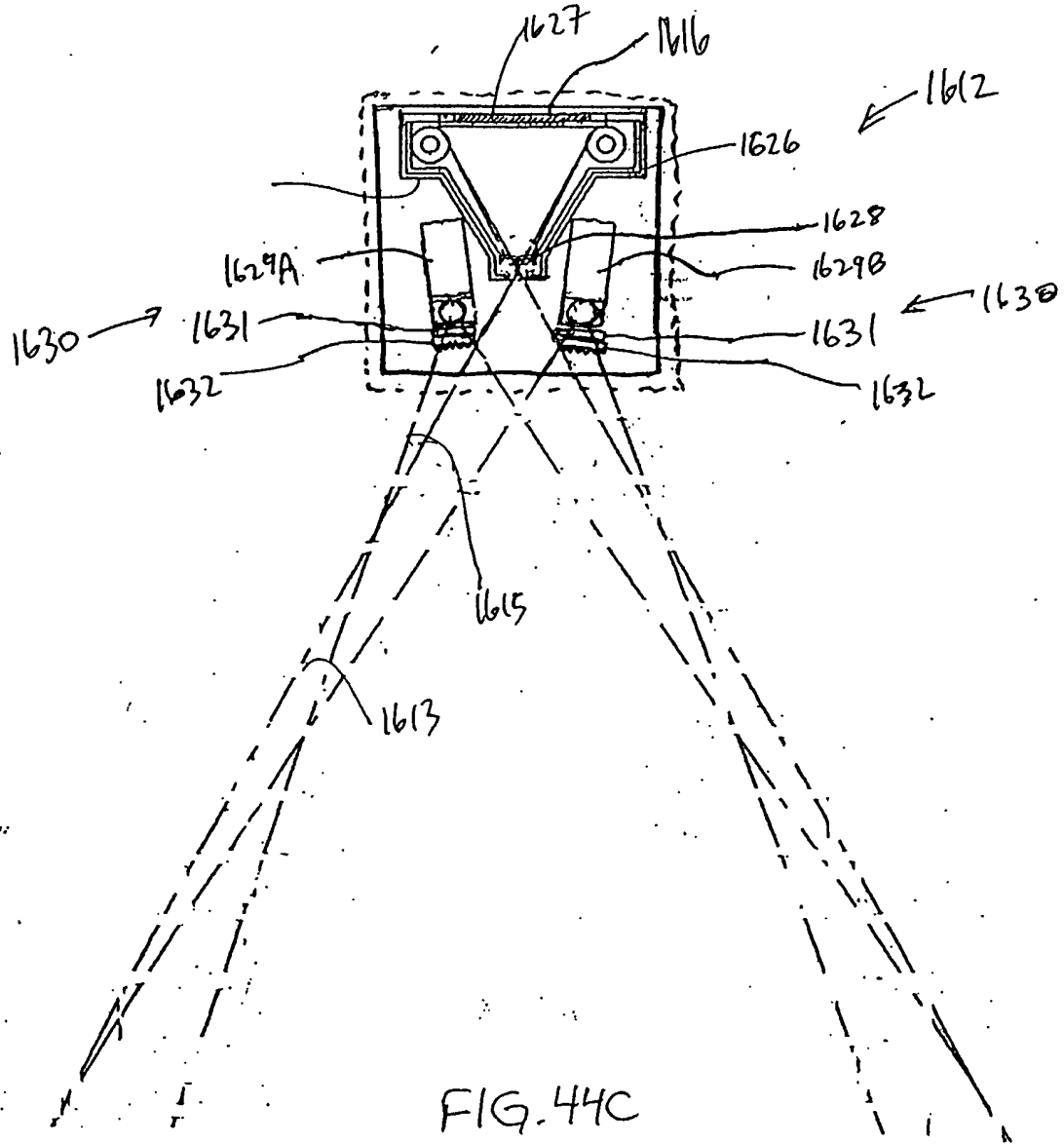


FIG. 44C

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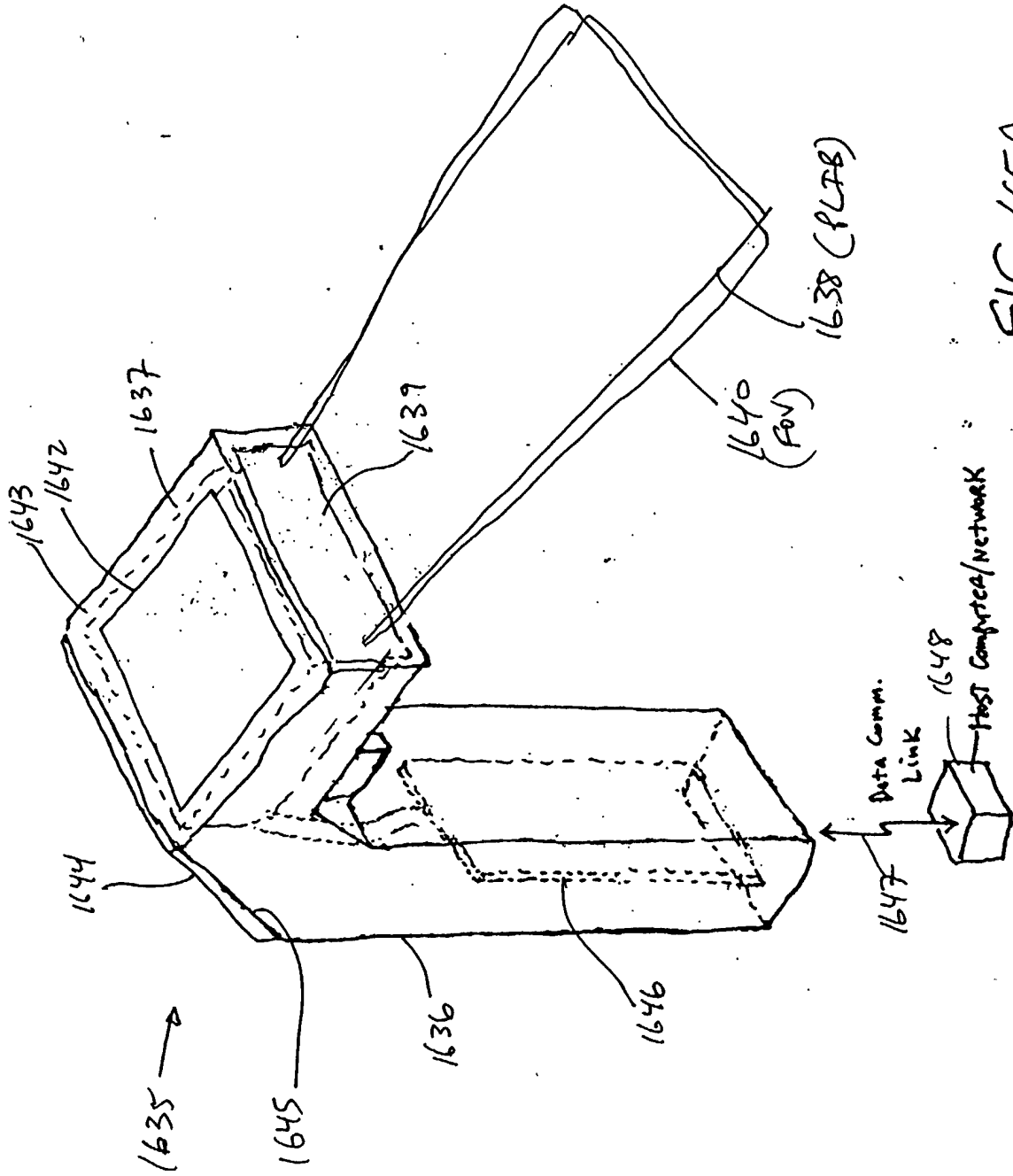


FIG. 45A

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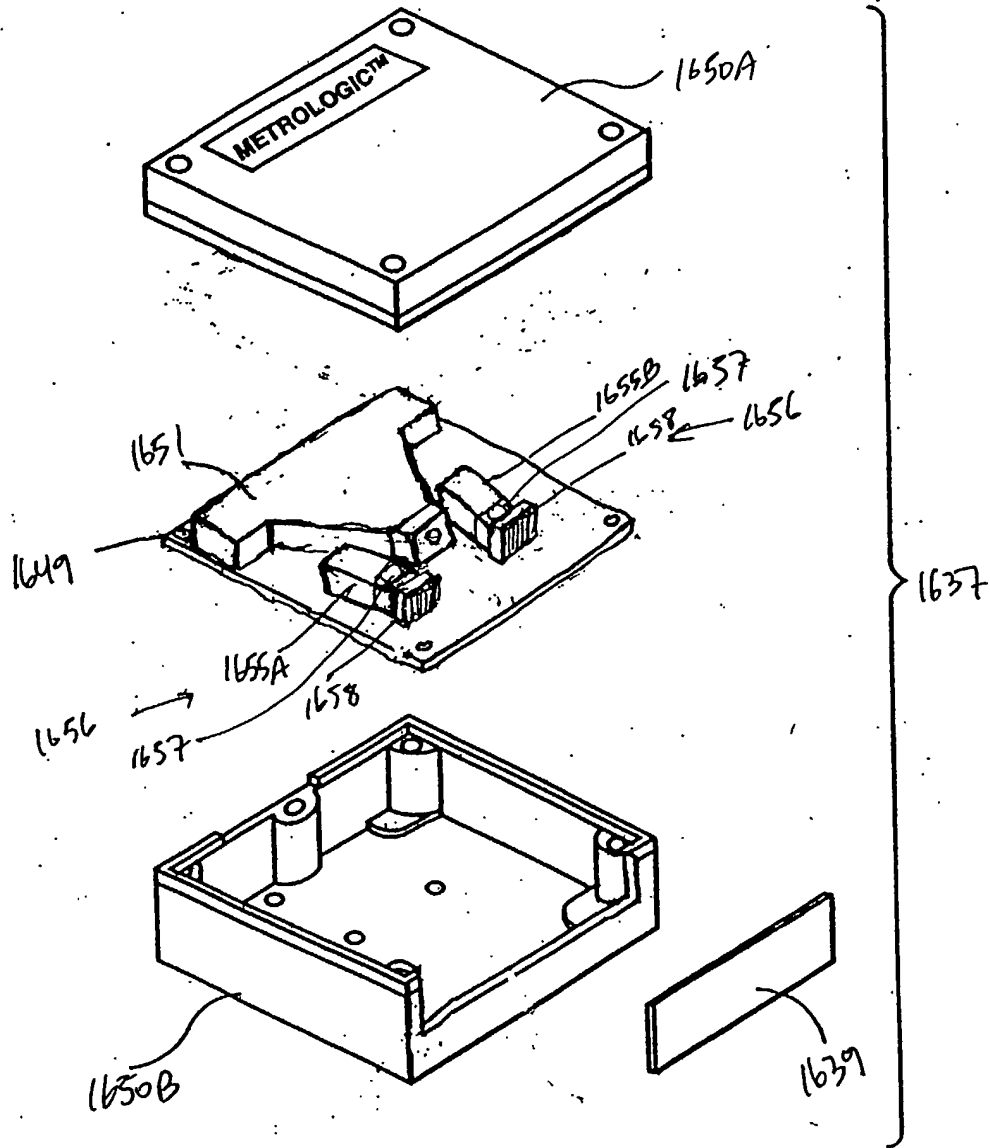
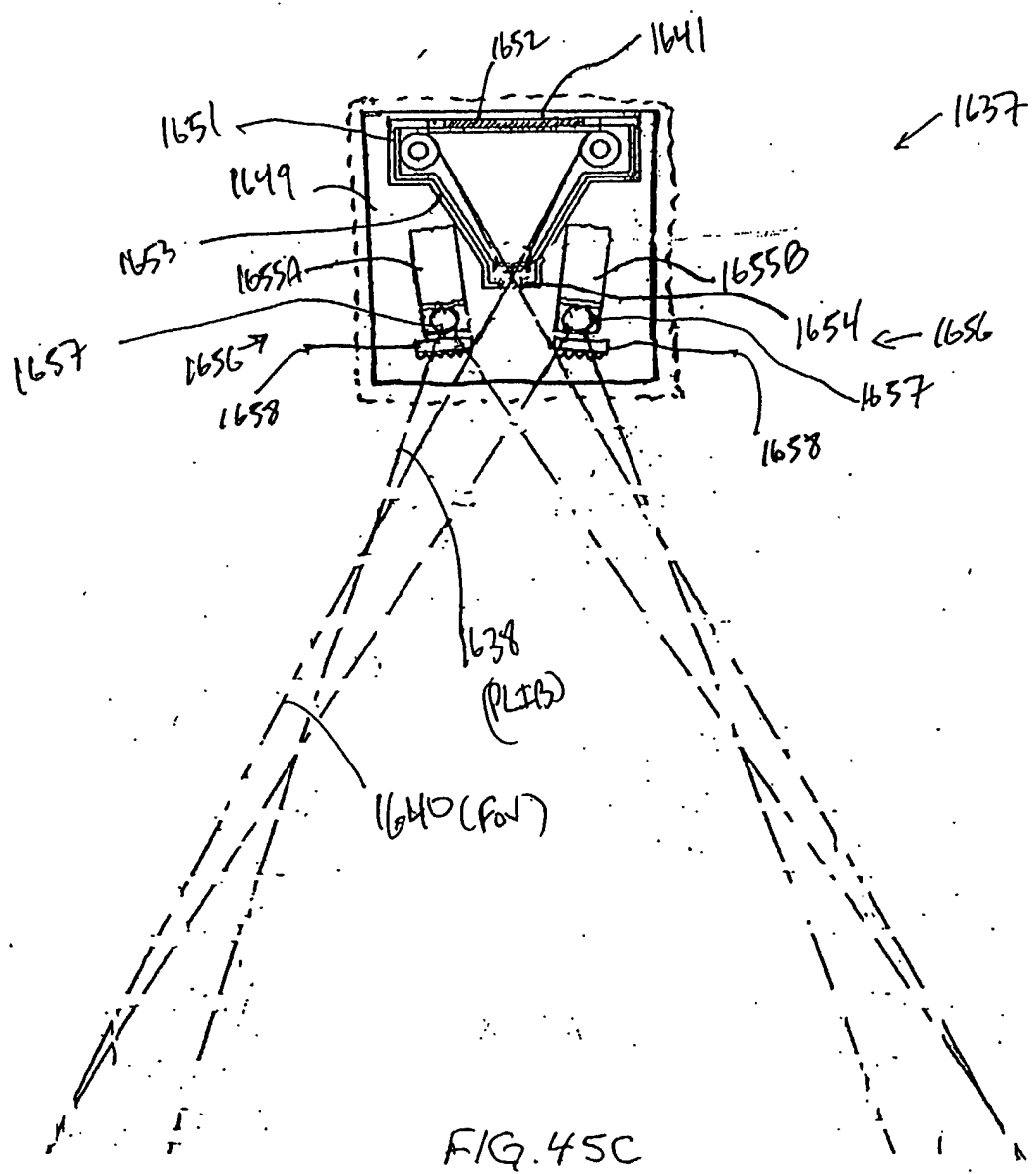


FIG. 45B

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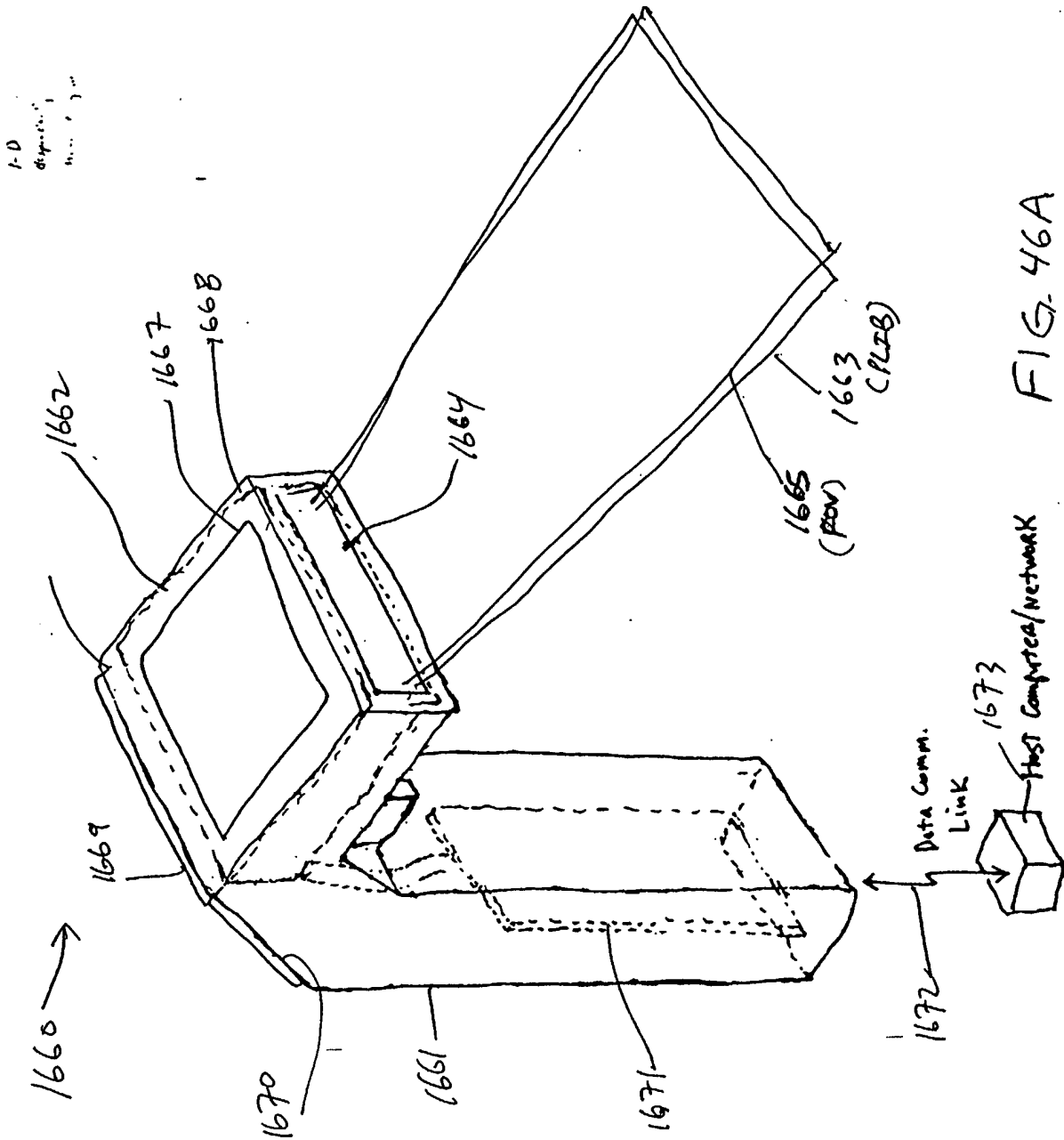


FIG. 46A

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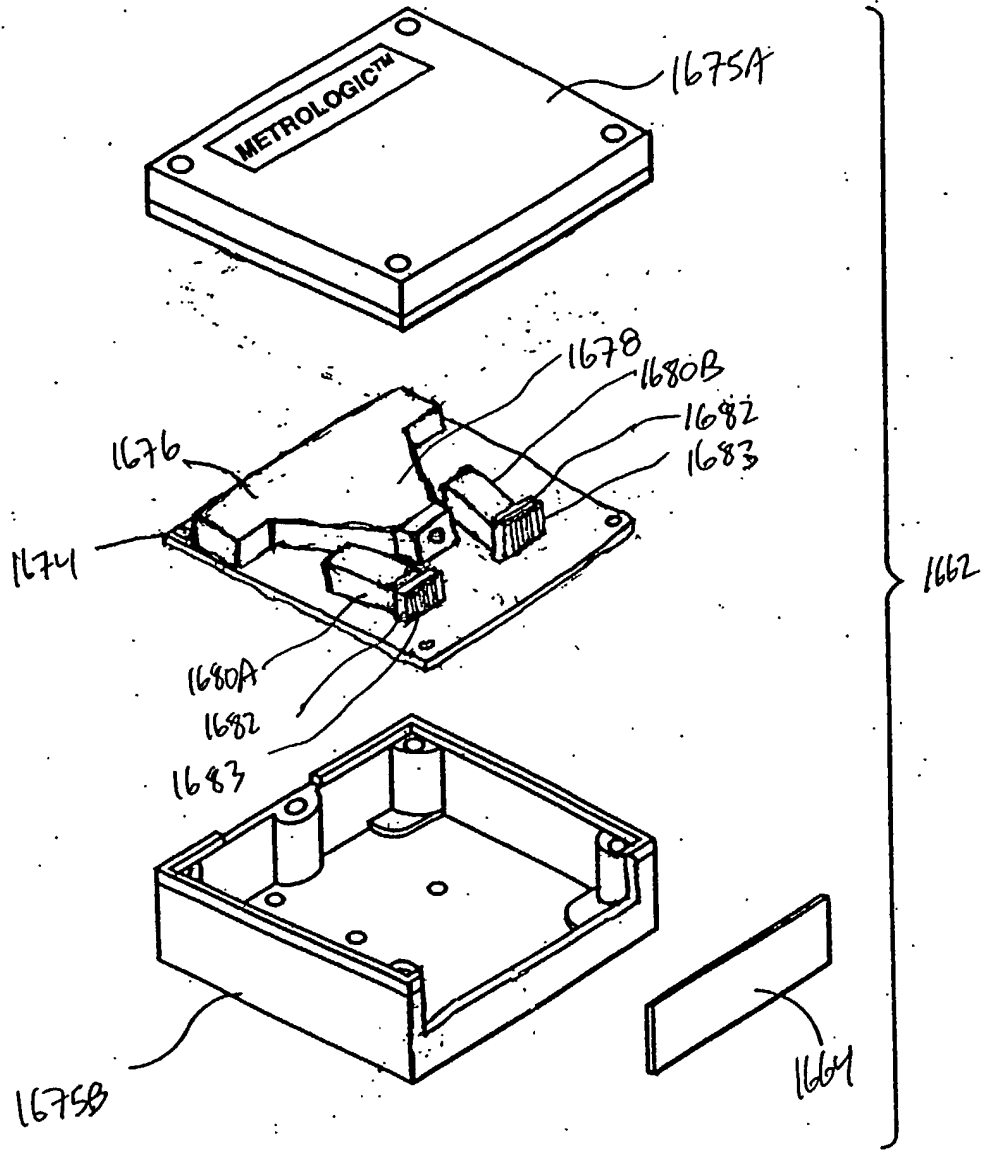
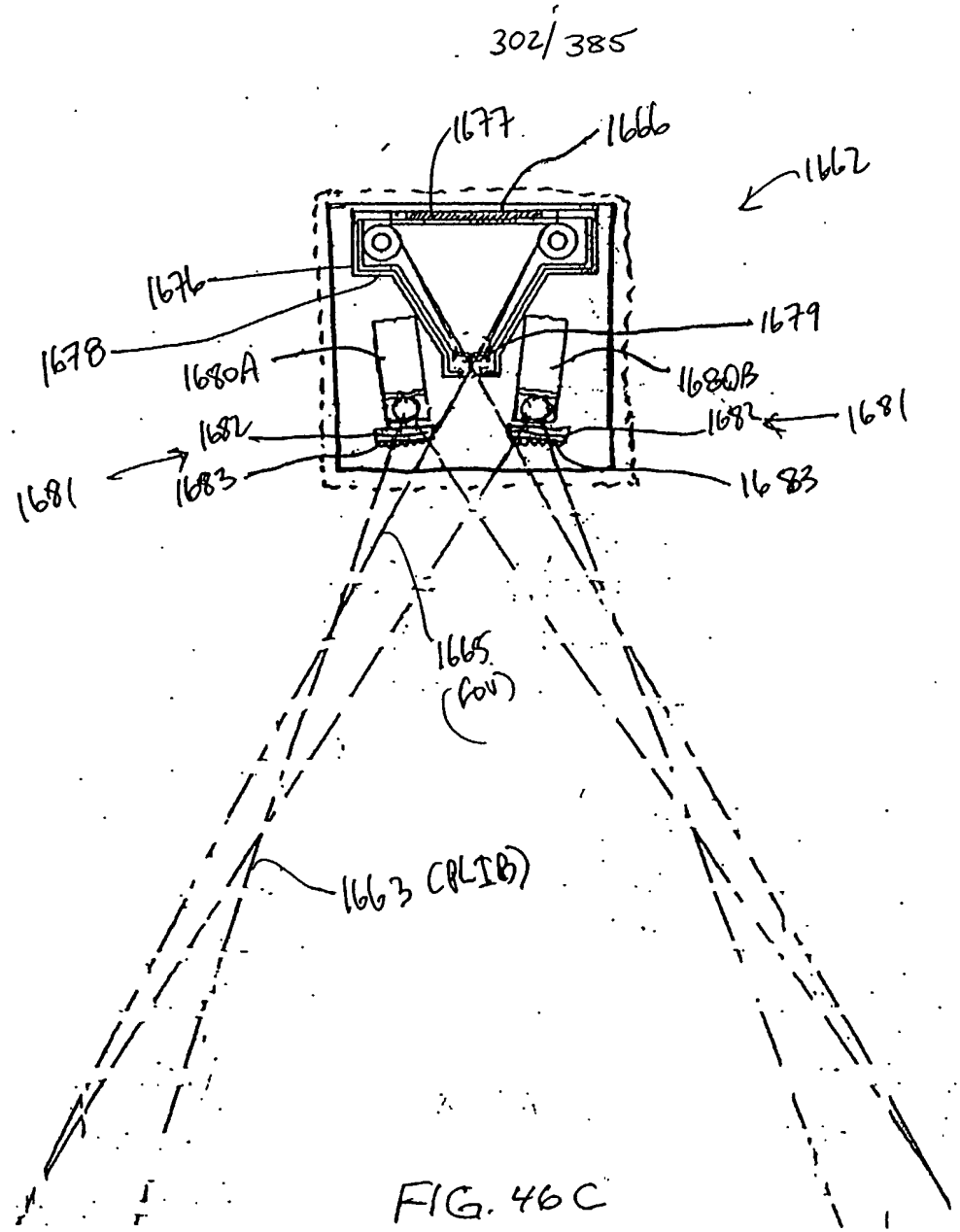


FIG. 46B



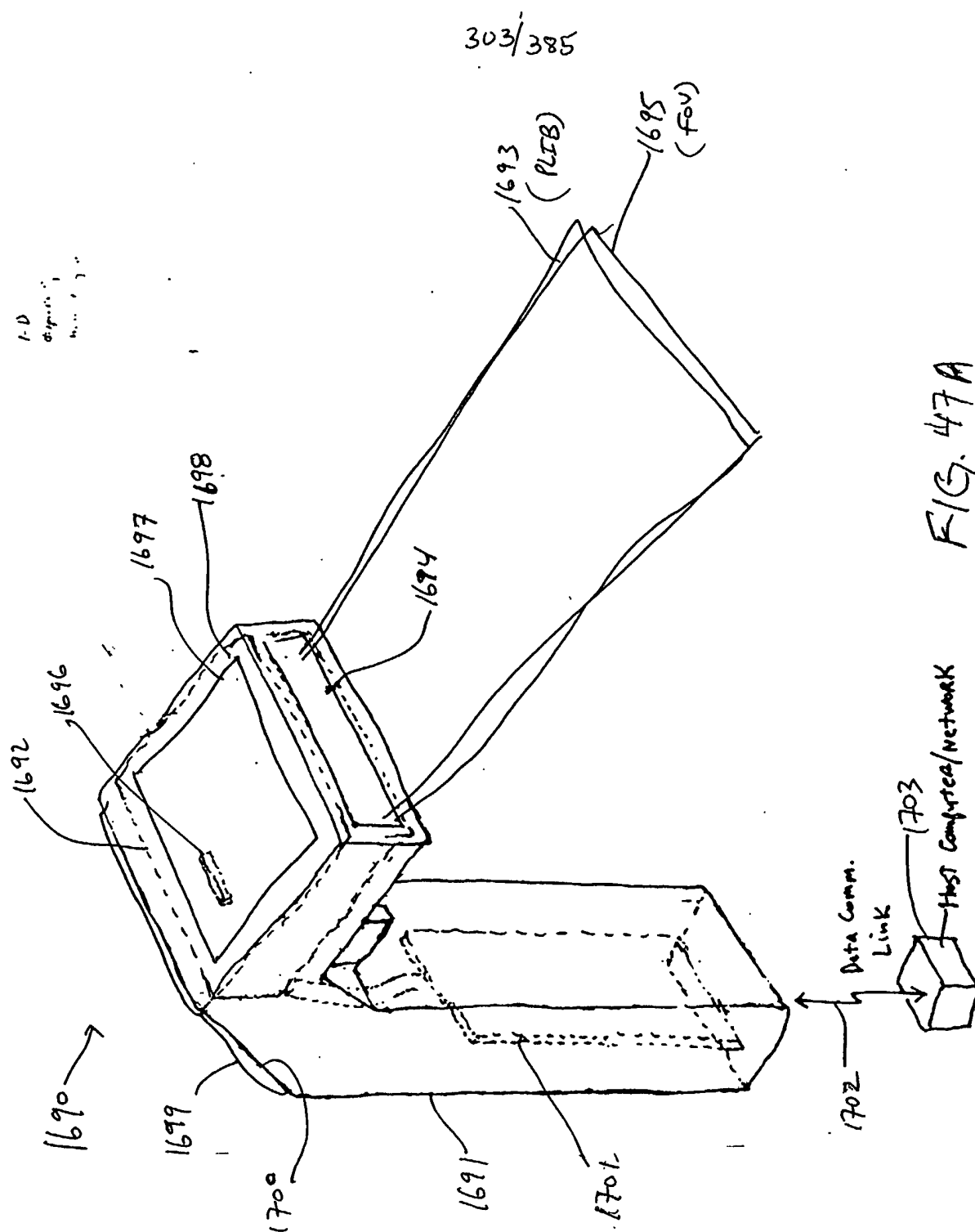


FIG. 47A

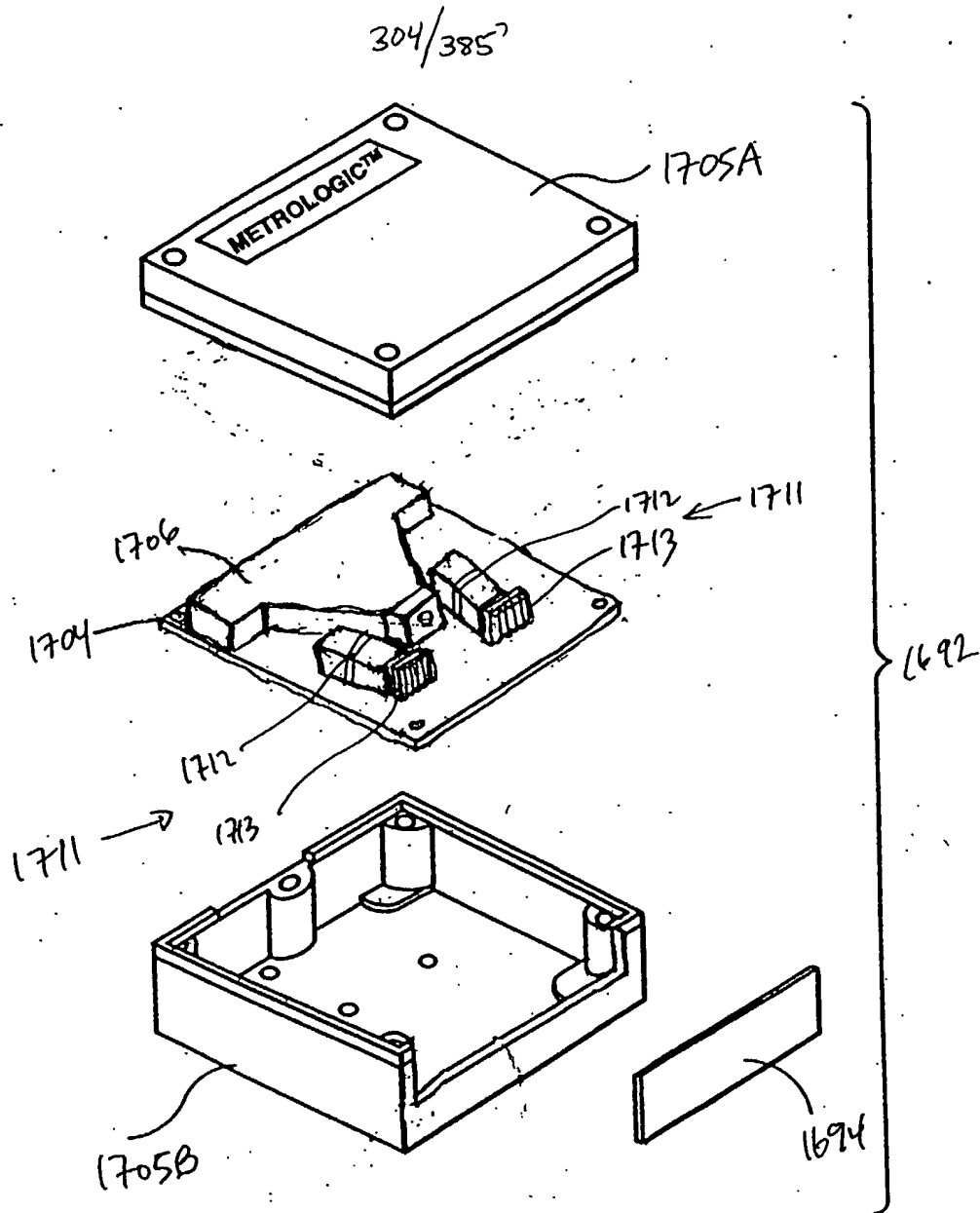


FIG. 47B

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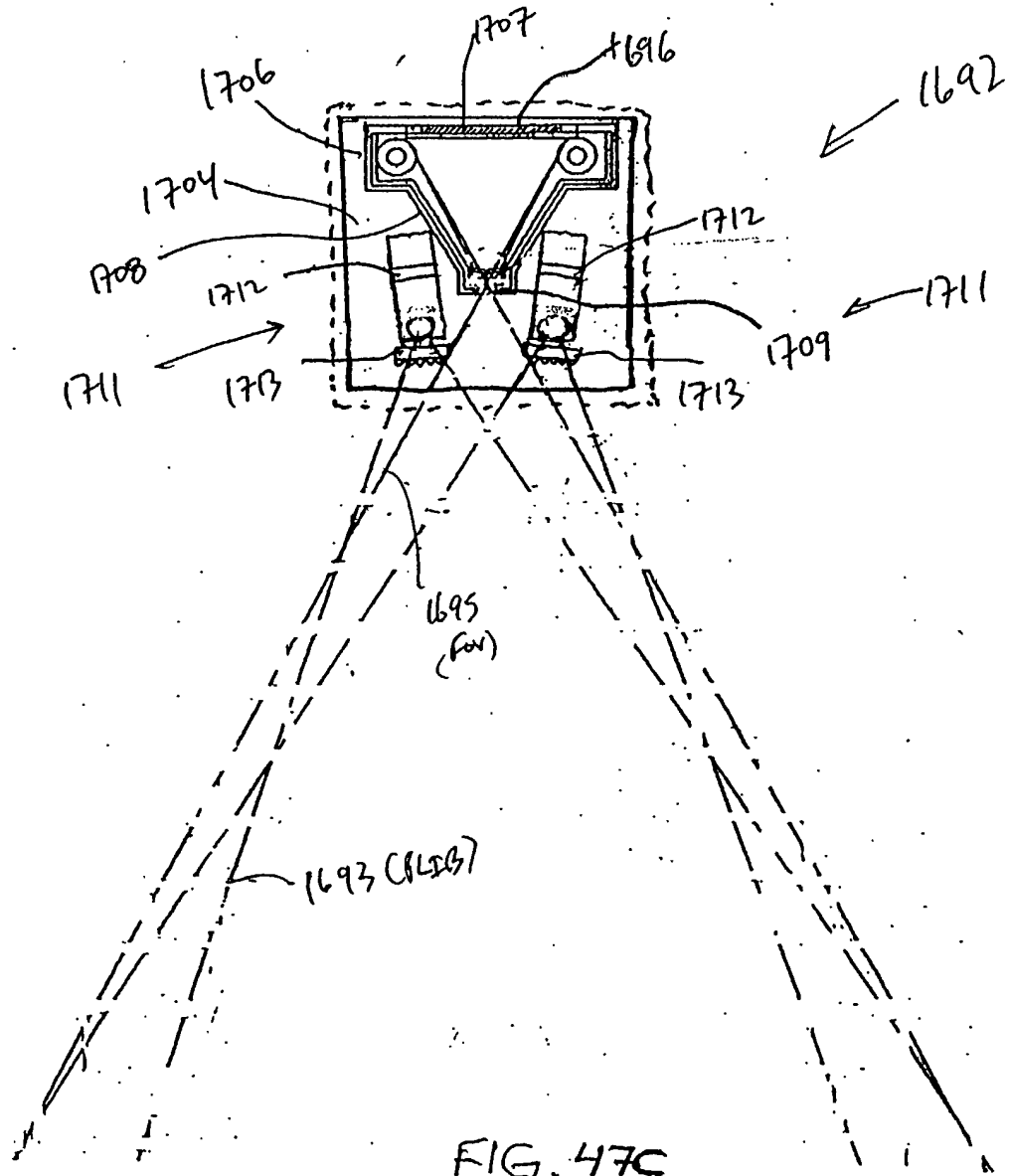


FIG. 47C

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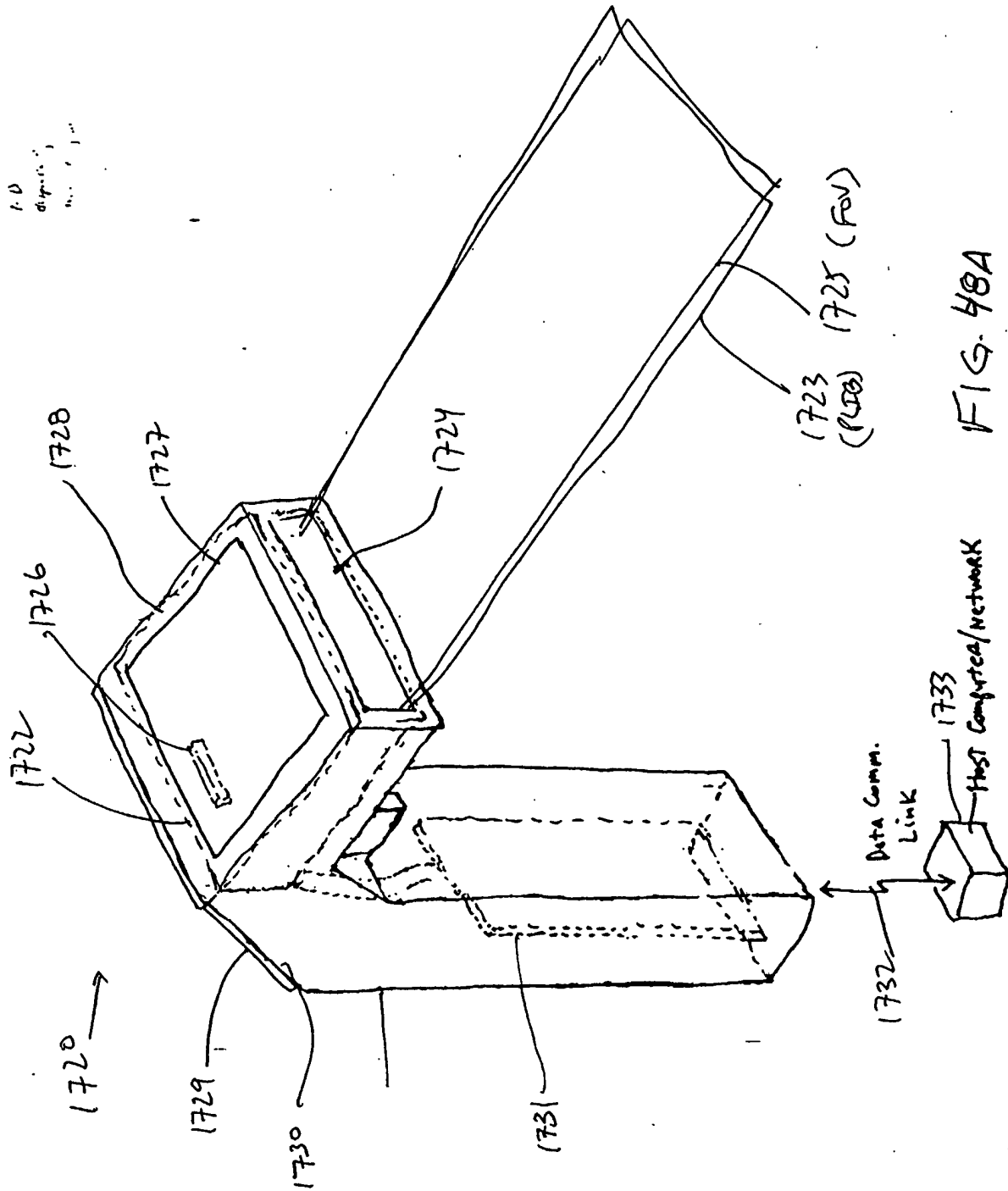


FIG. 48A

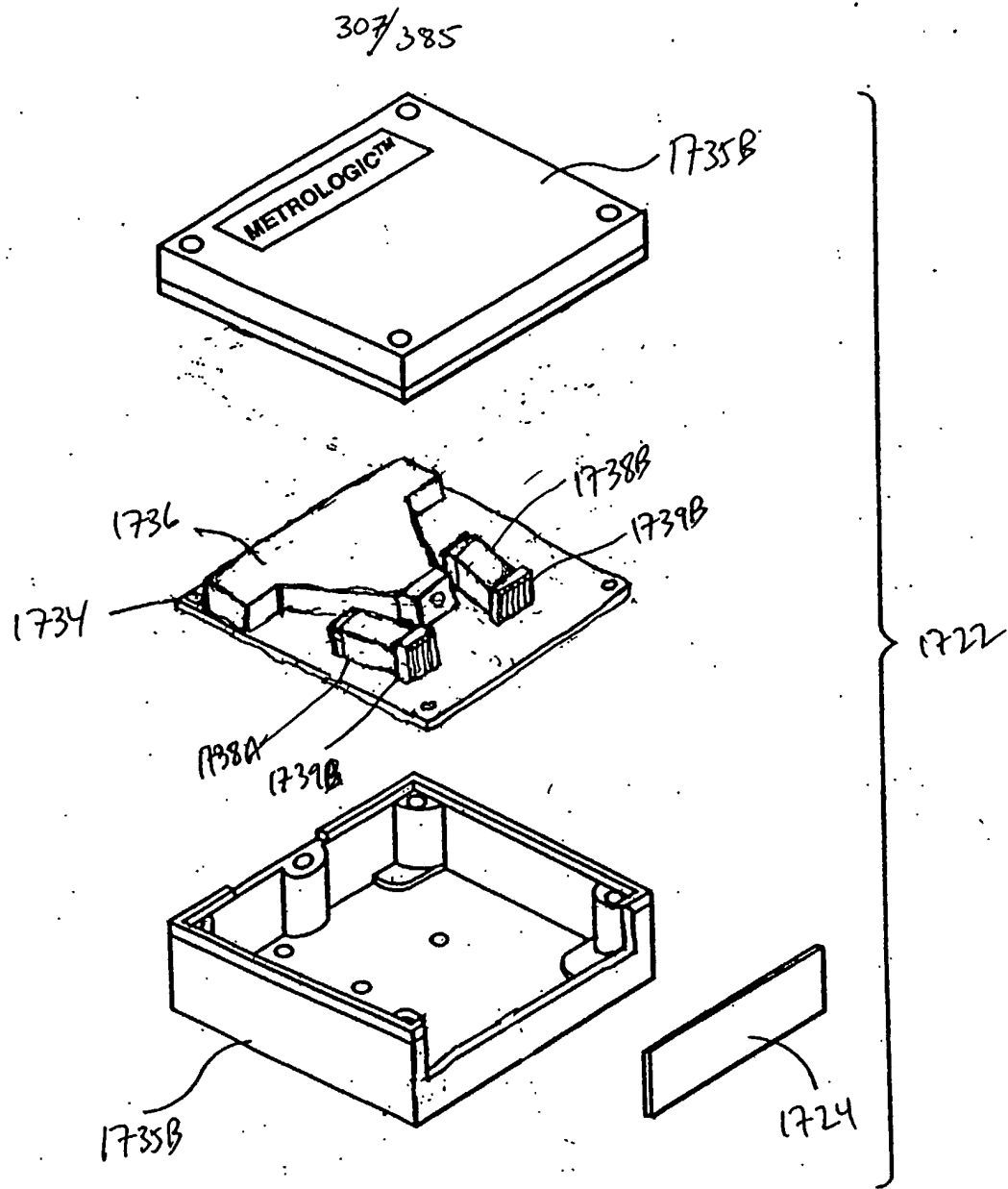
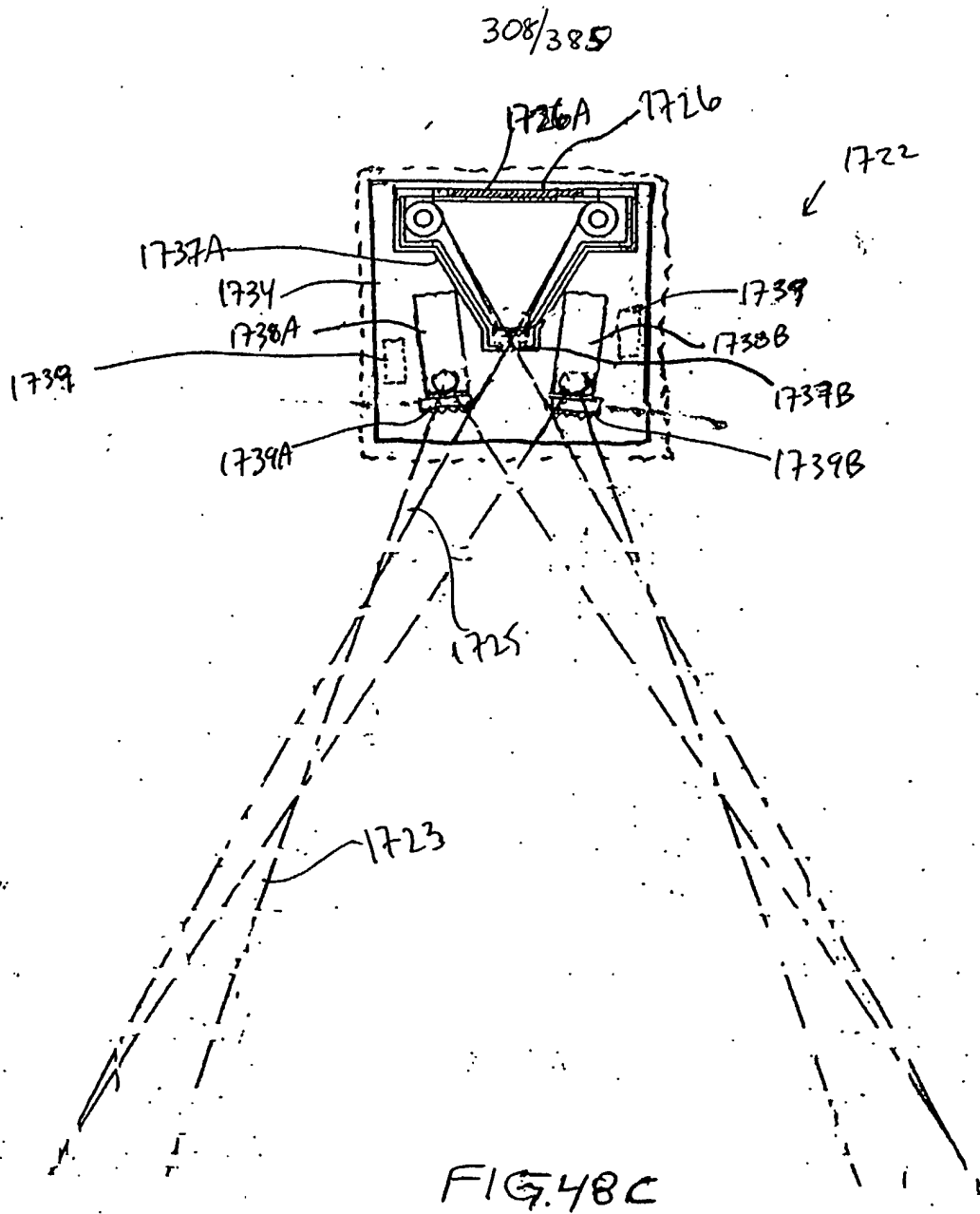
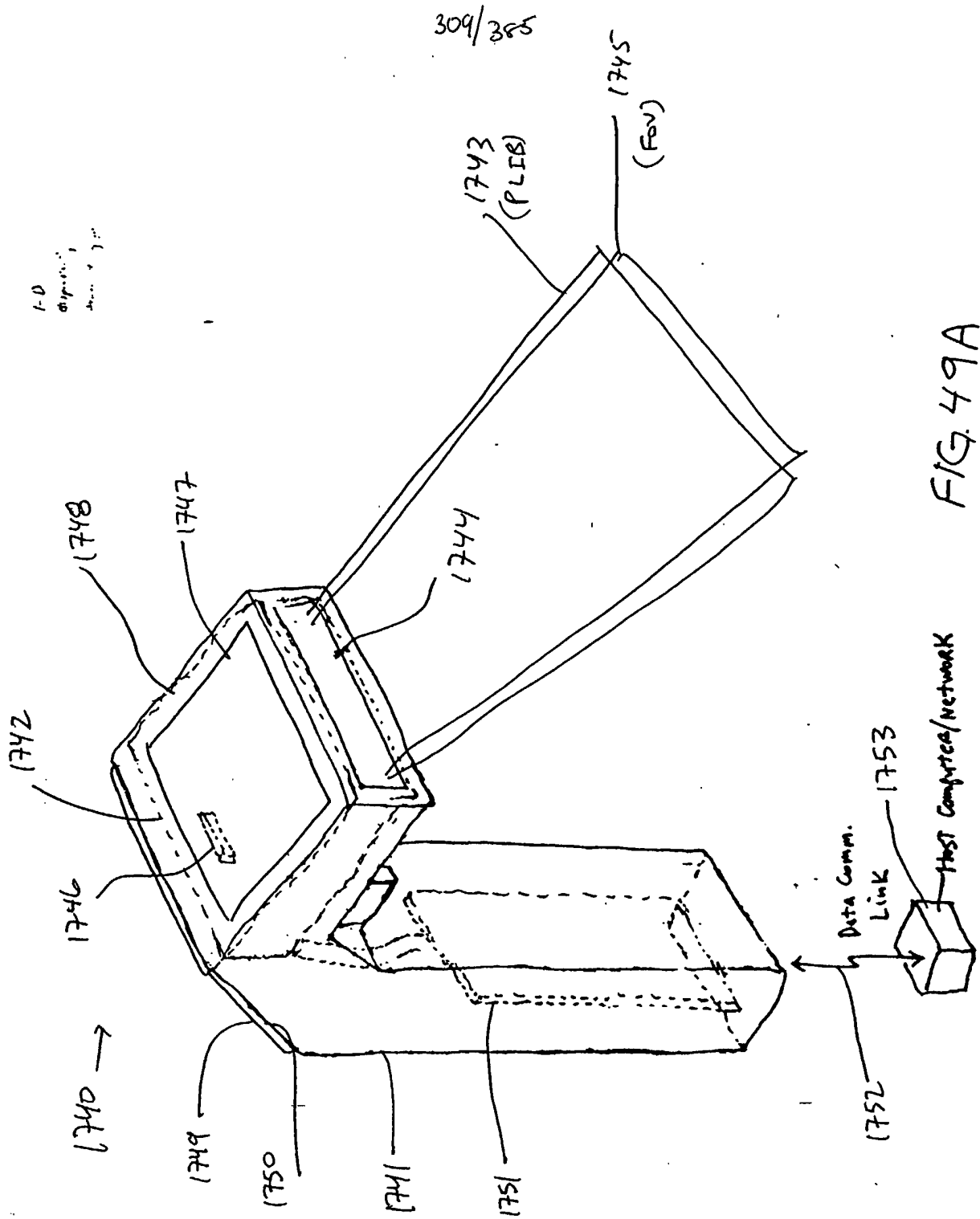


FIG. 48B







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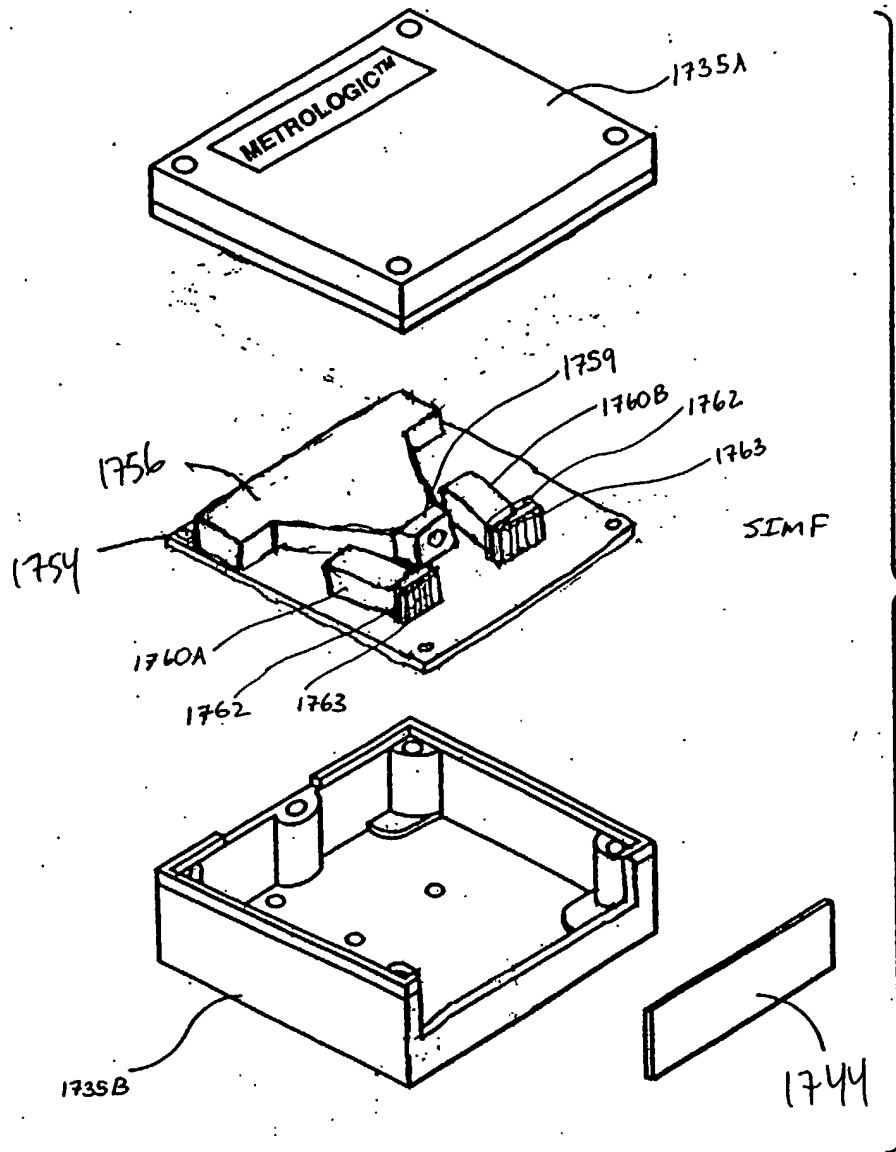
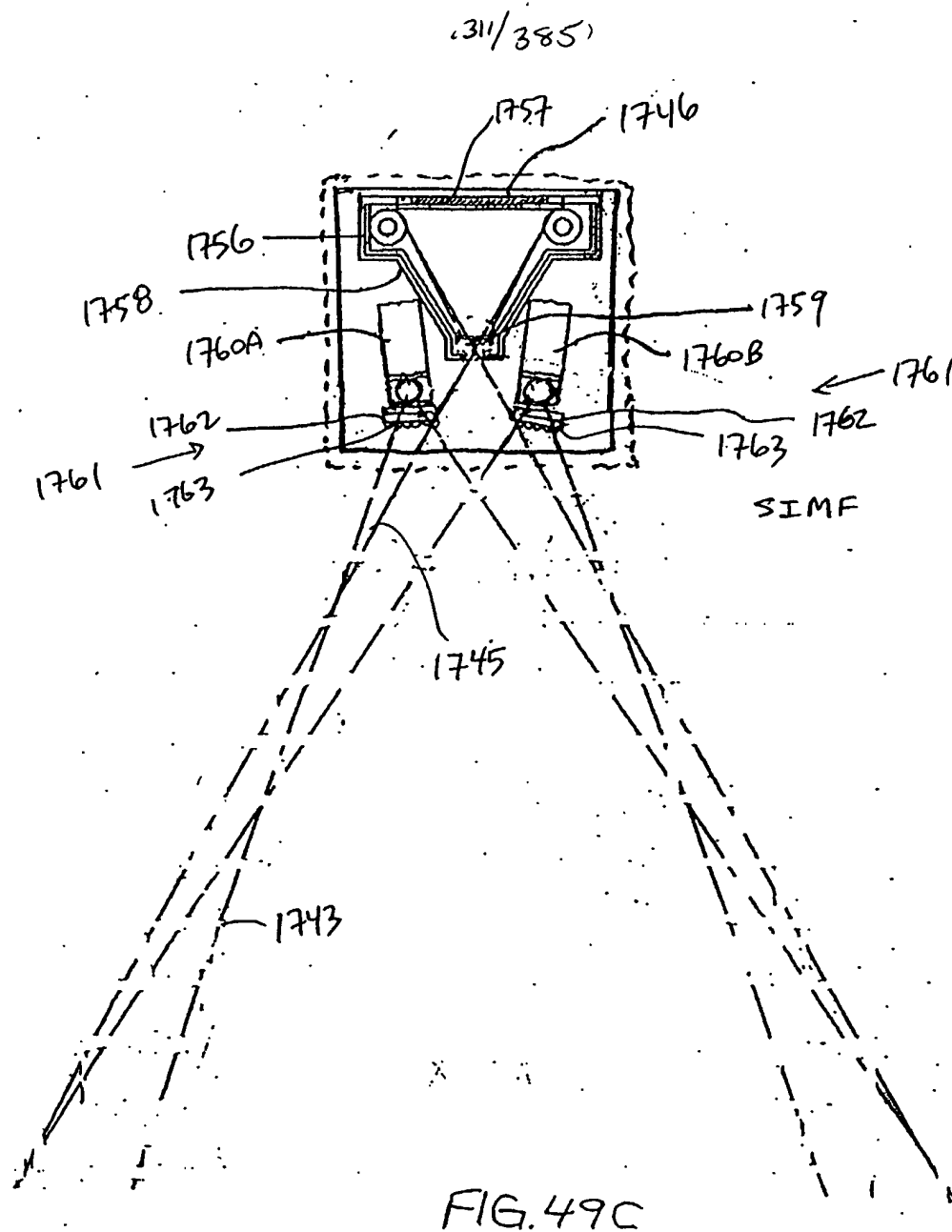


FIG. 49B



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1-D  
display  
showing 3D

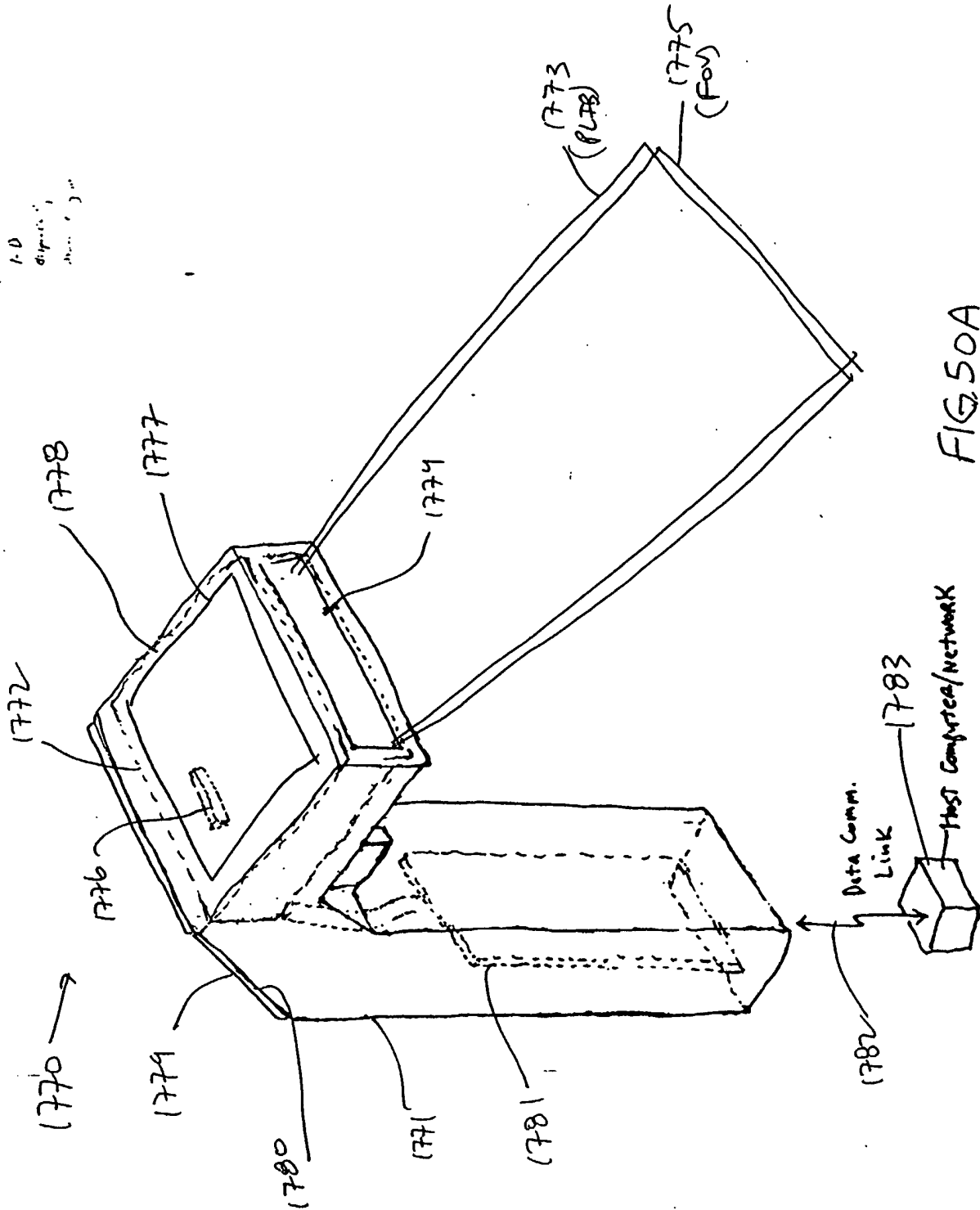


FIG. 50A

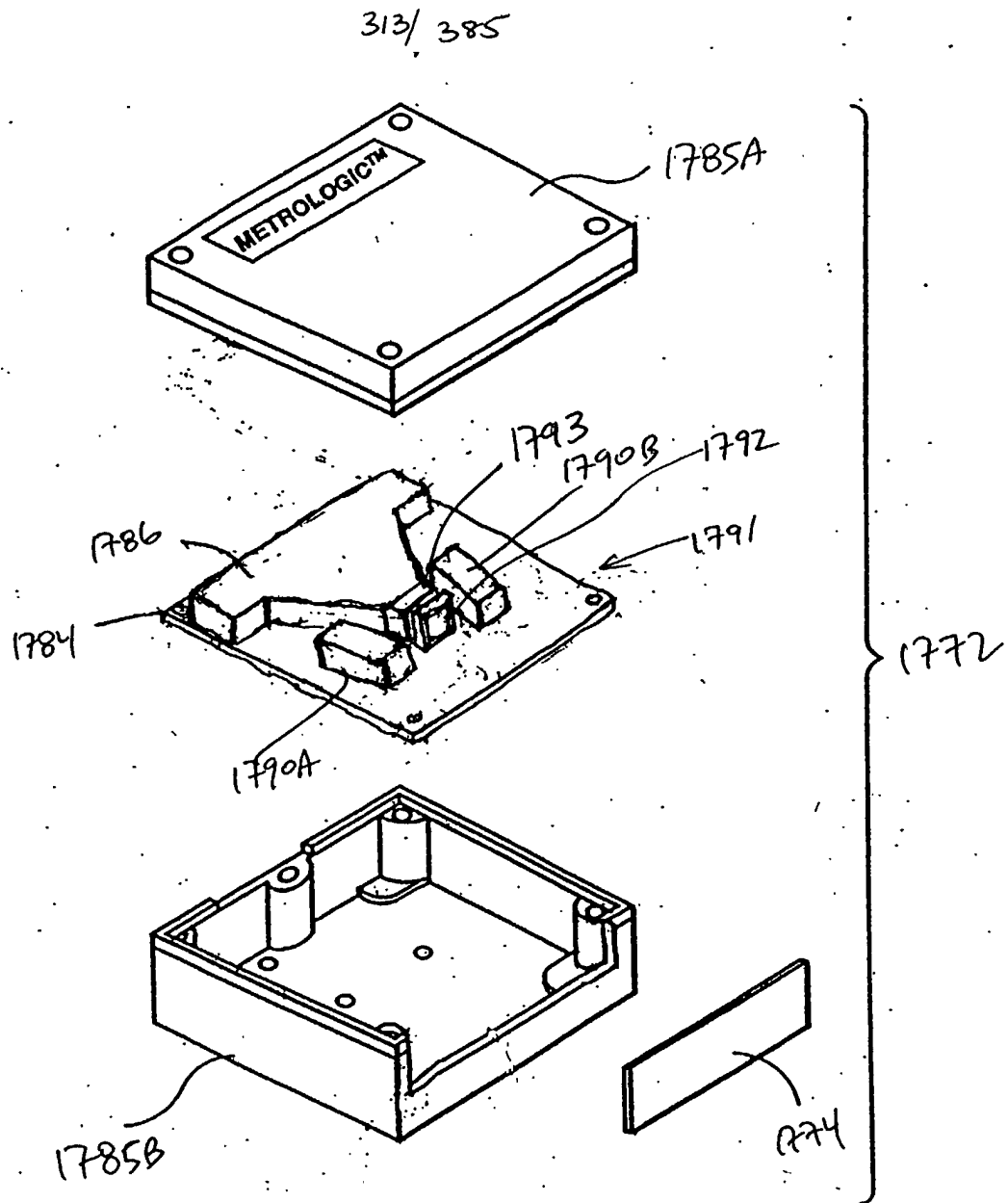


FIG. 50B

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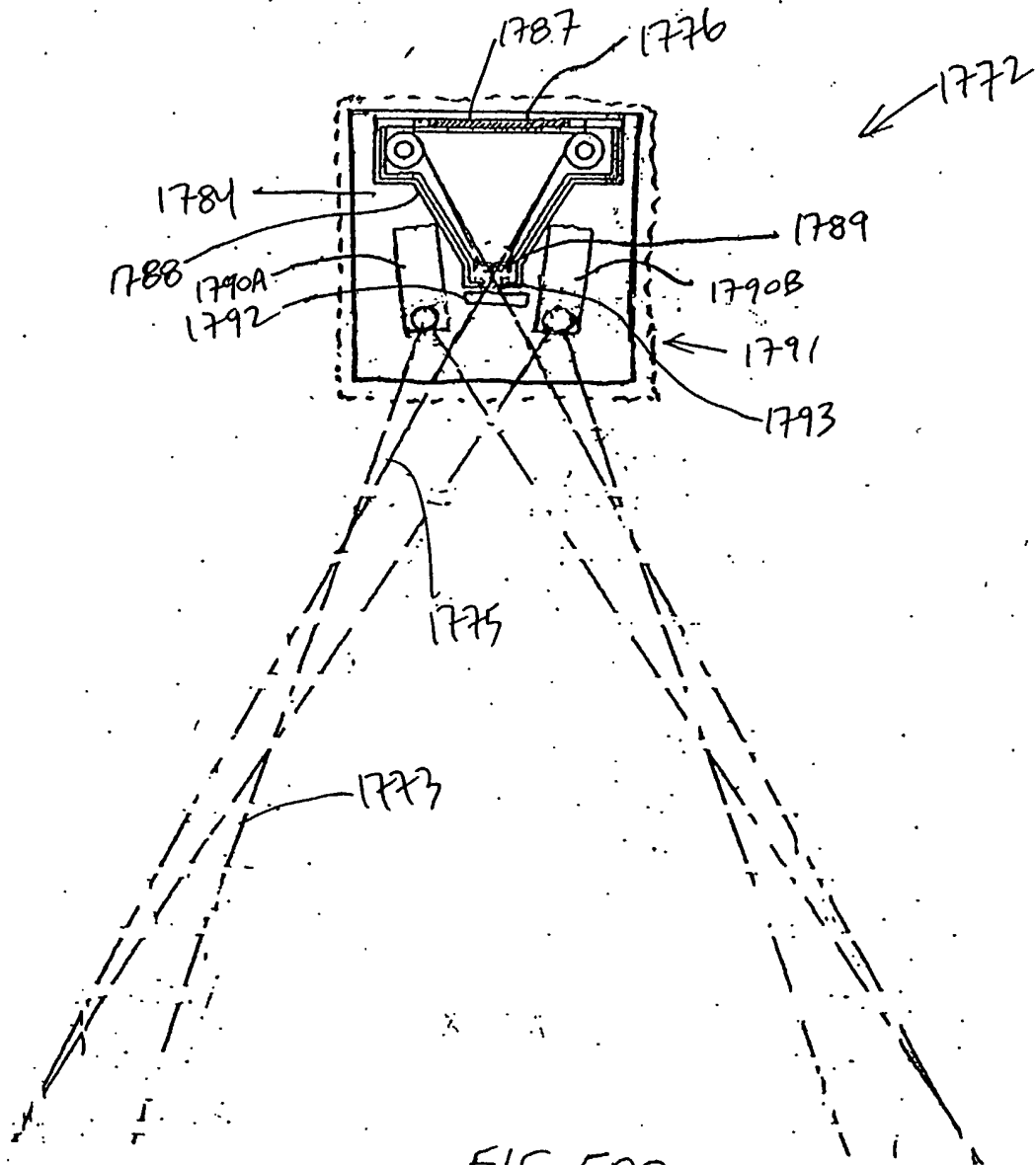
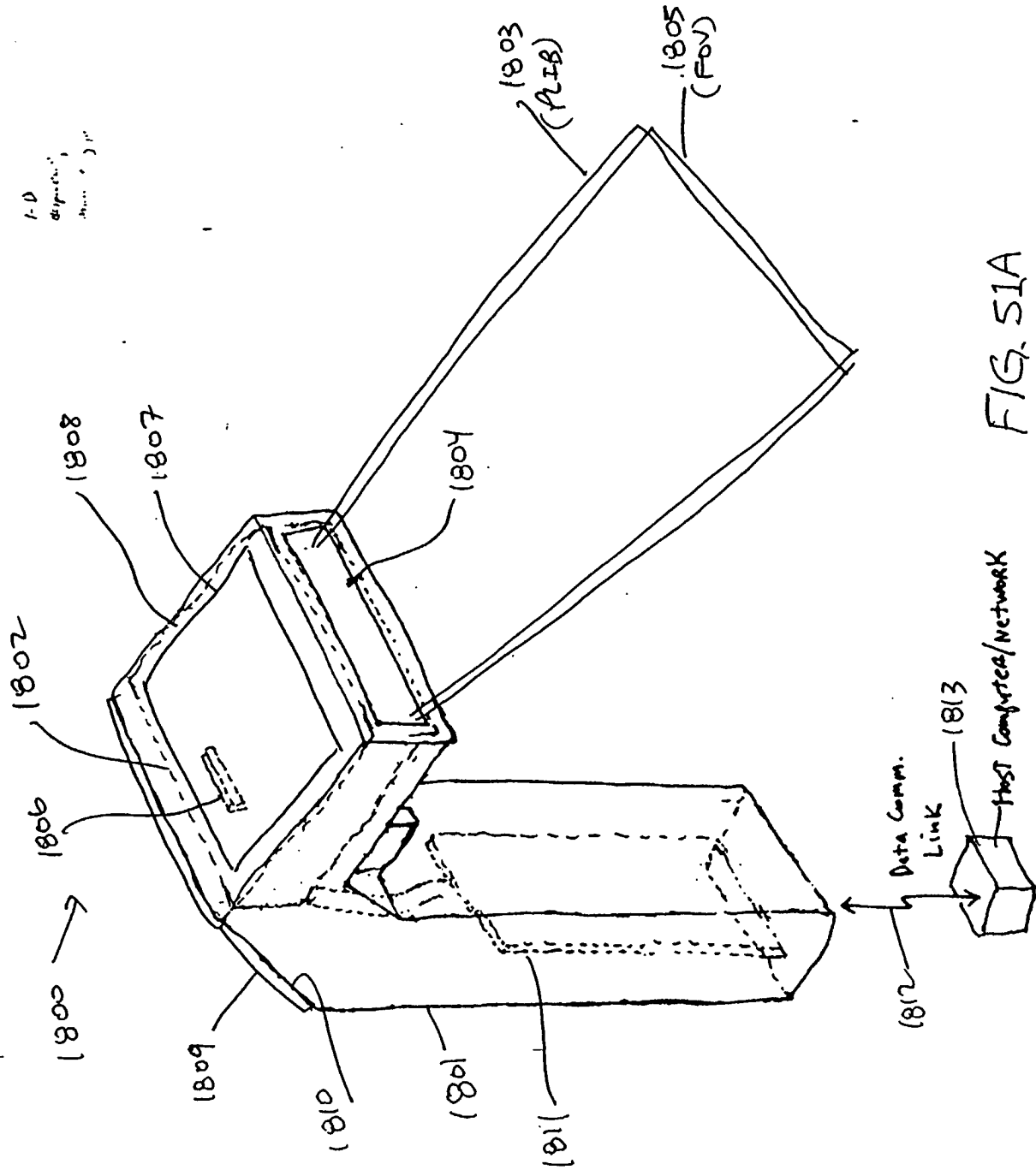


FIG. 50C

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1-D  
display  
unit





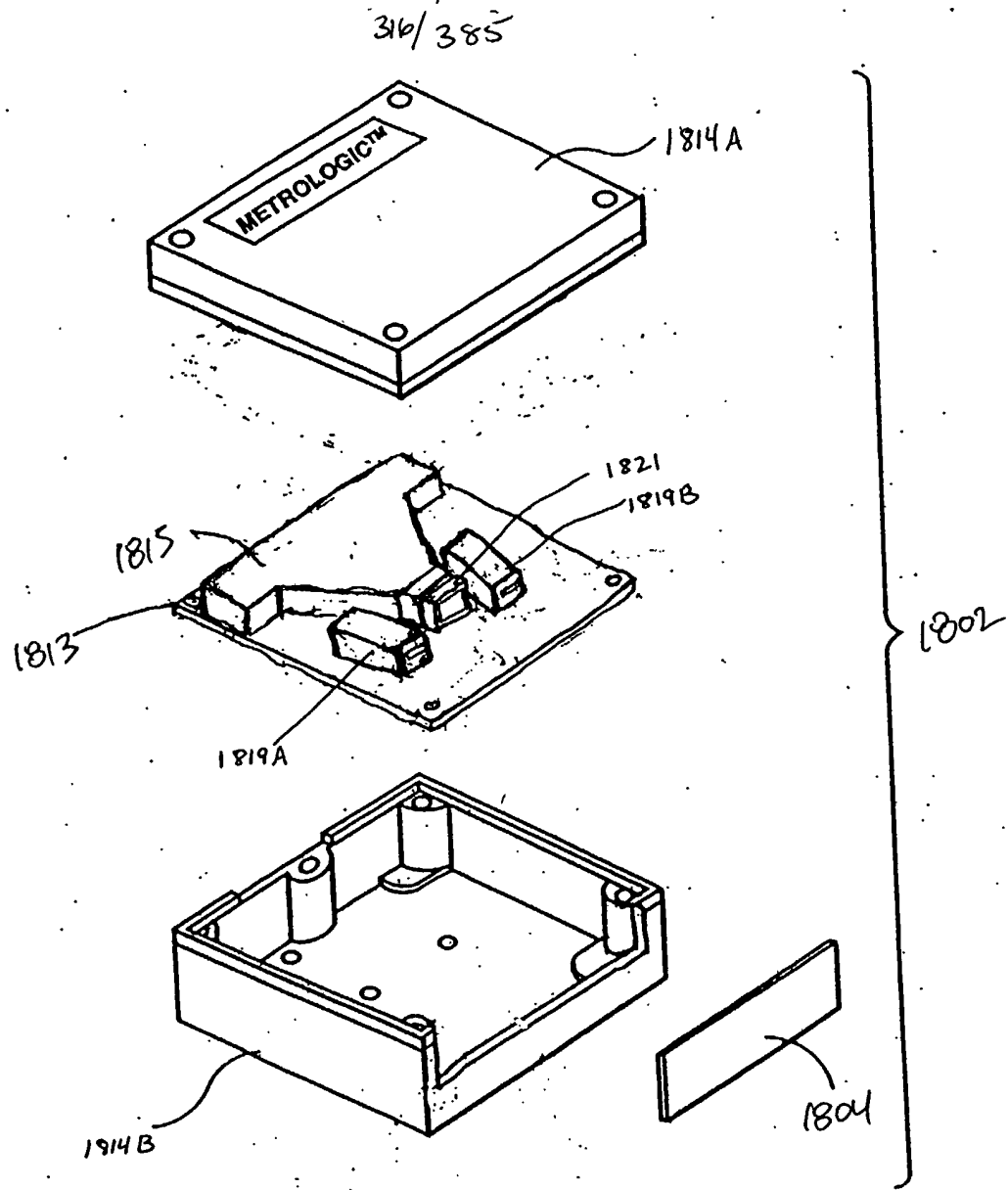
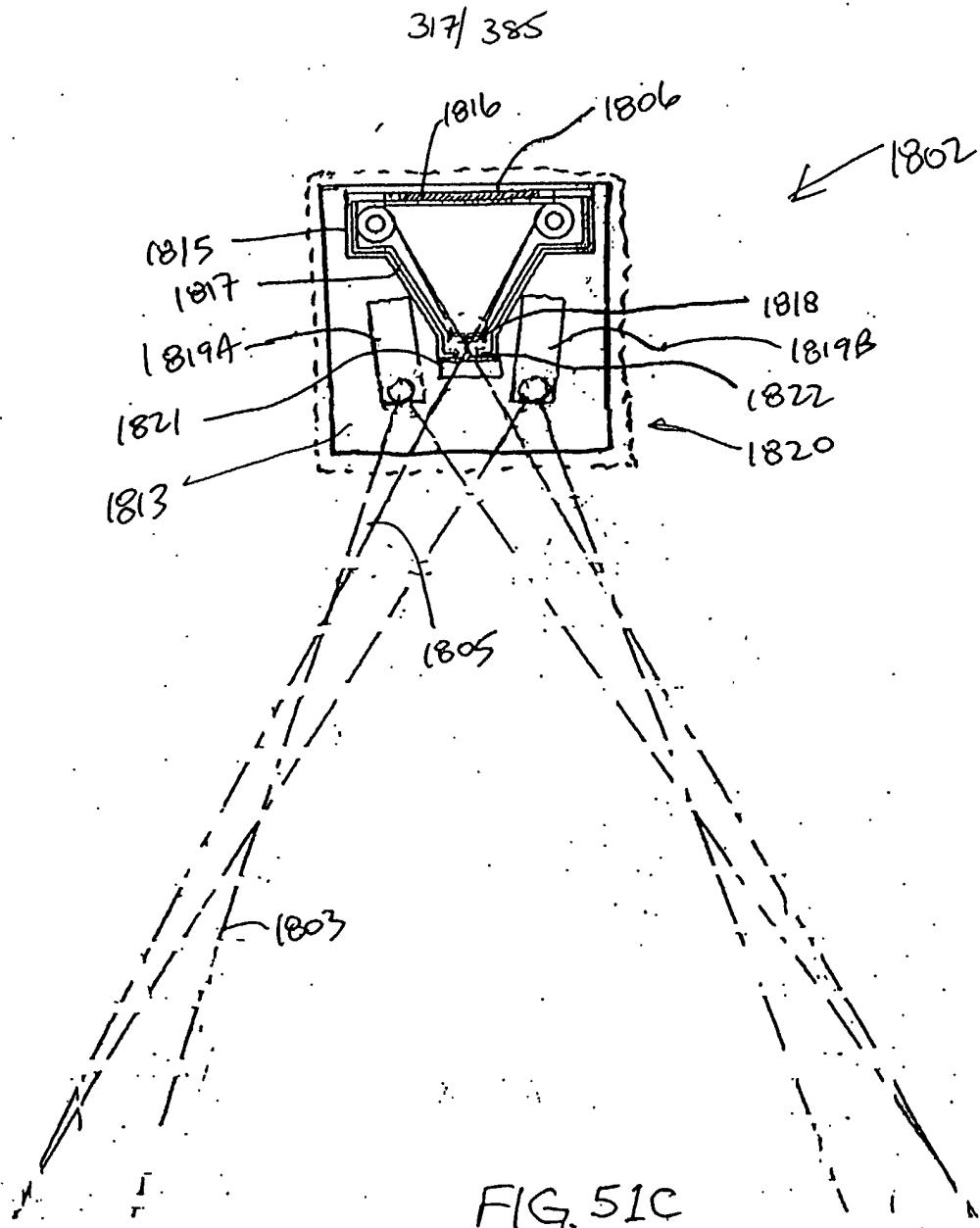


FIG. 51B



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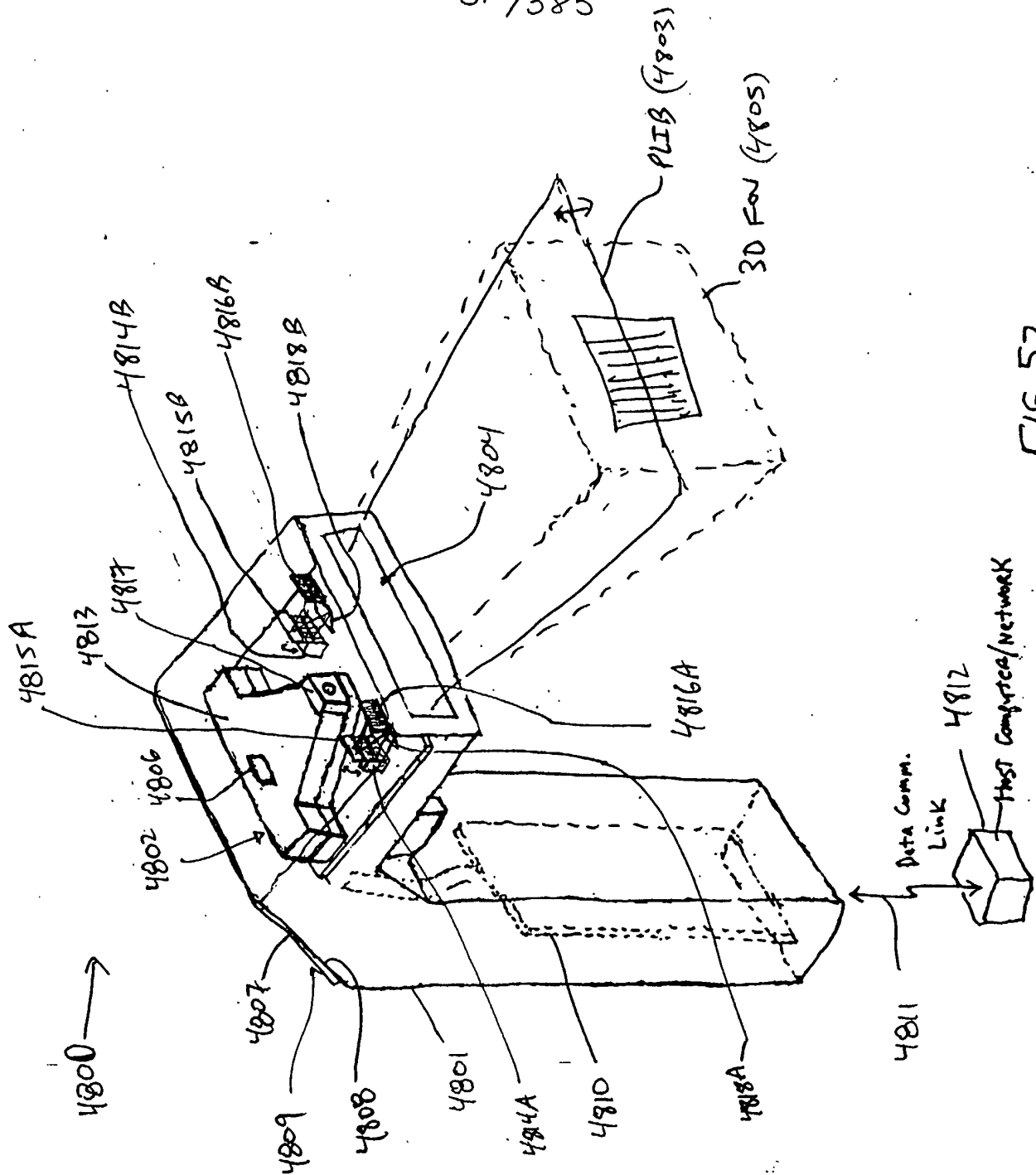
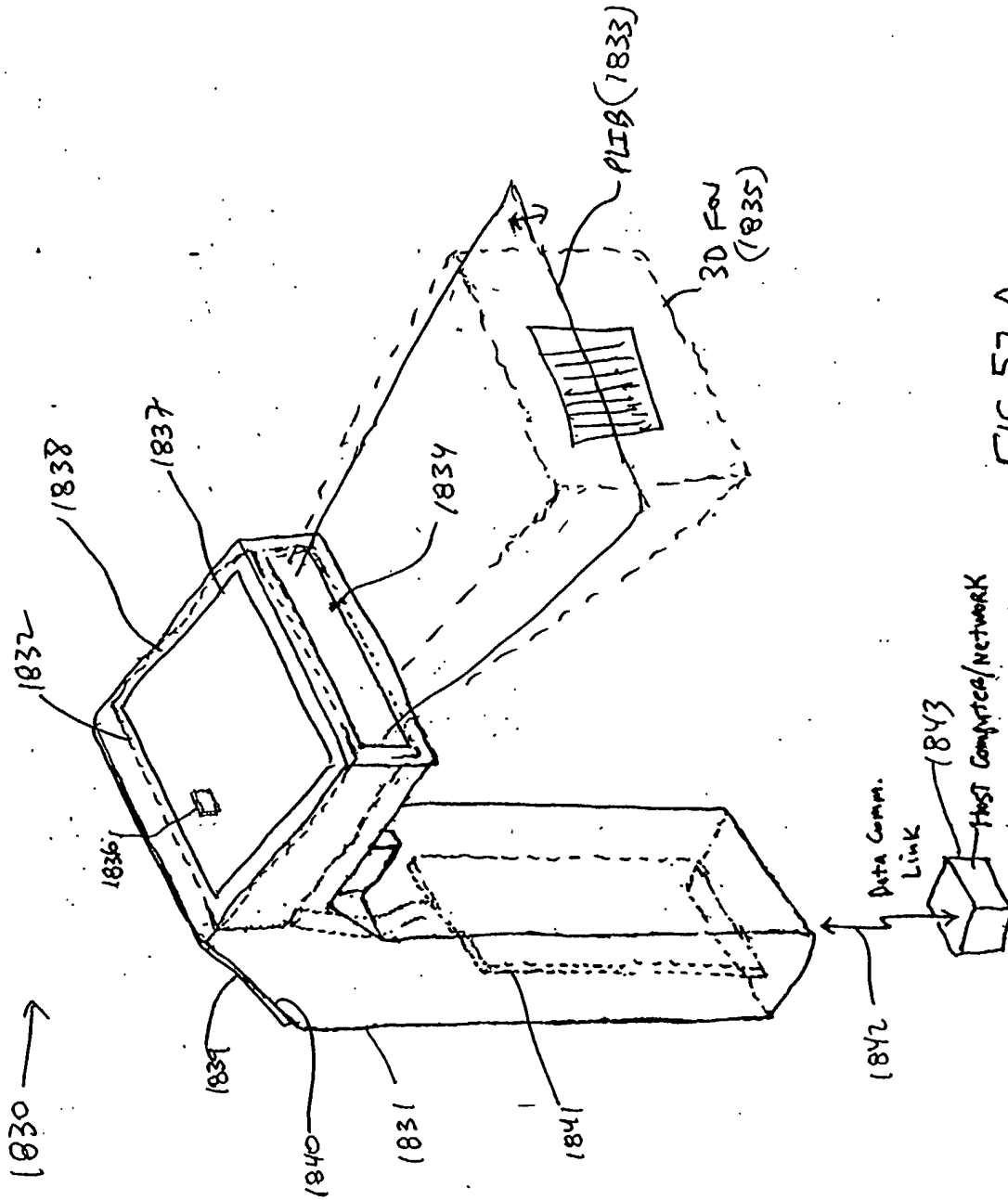


FIG. 52

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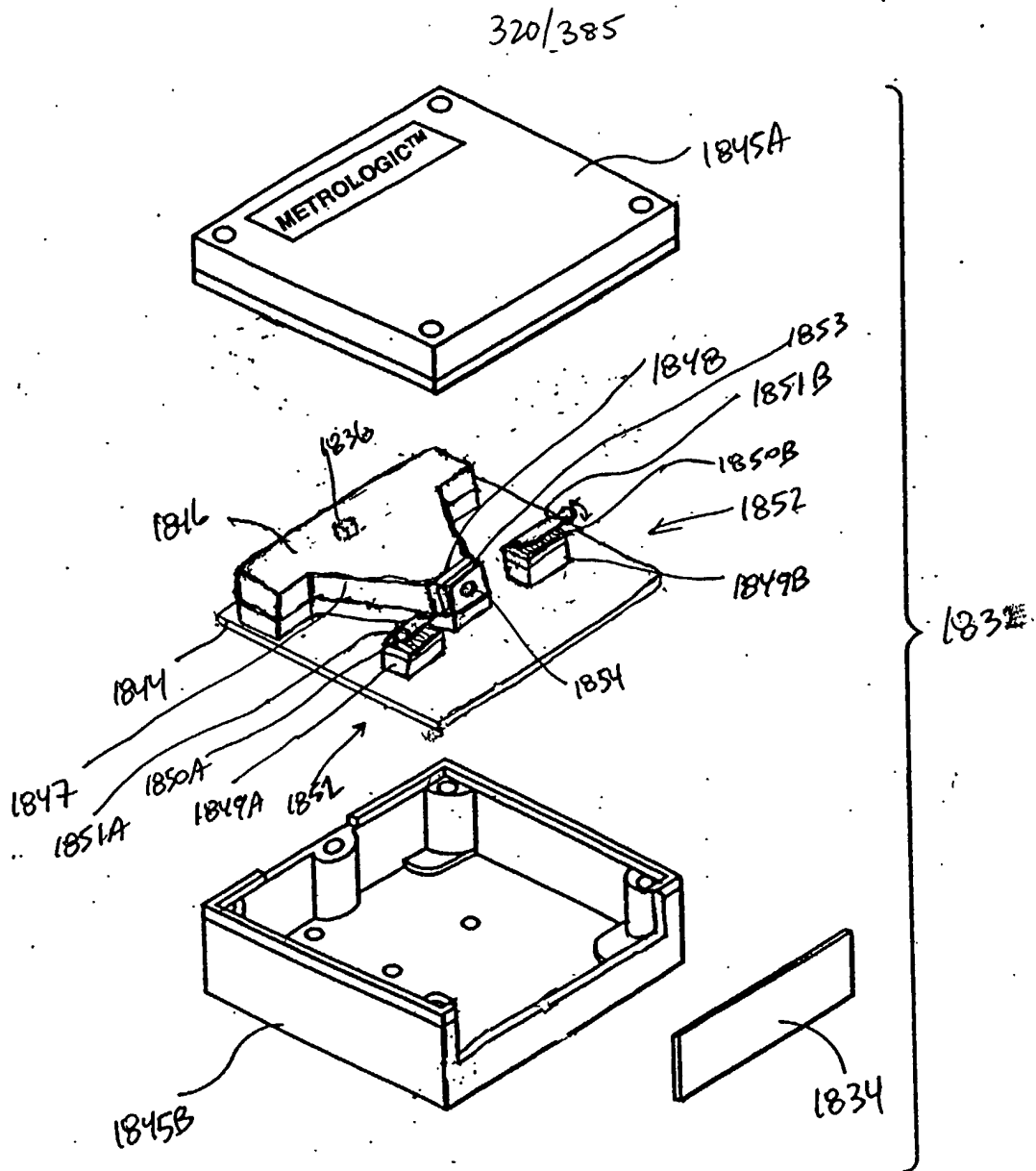


FIG. 52B

Fig. 1I3A-3B

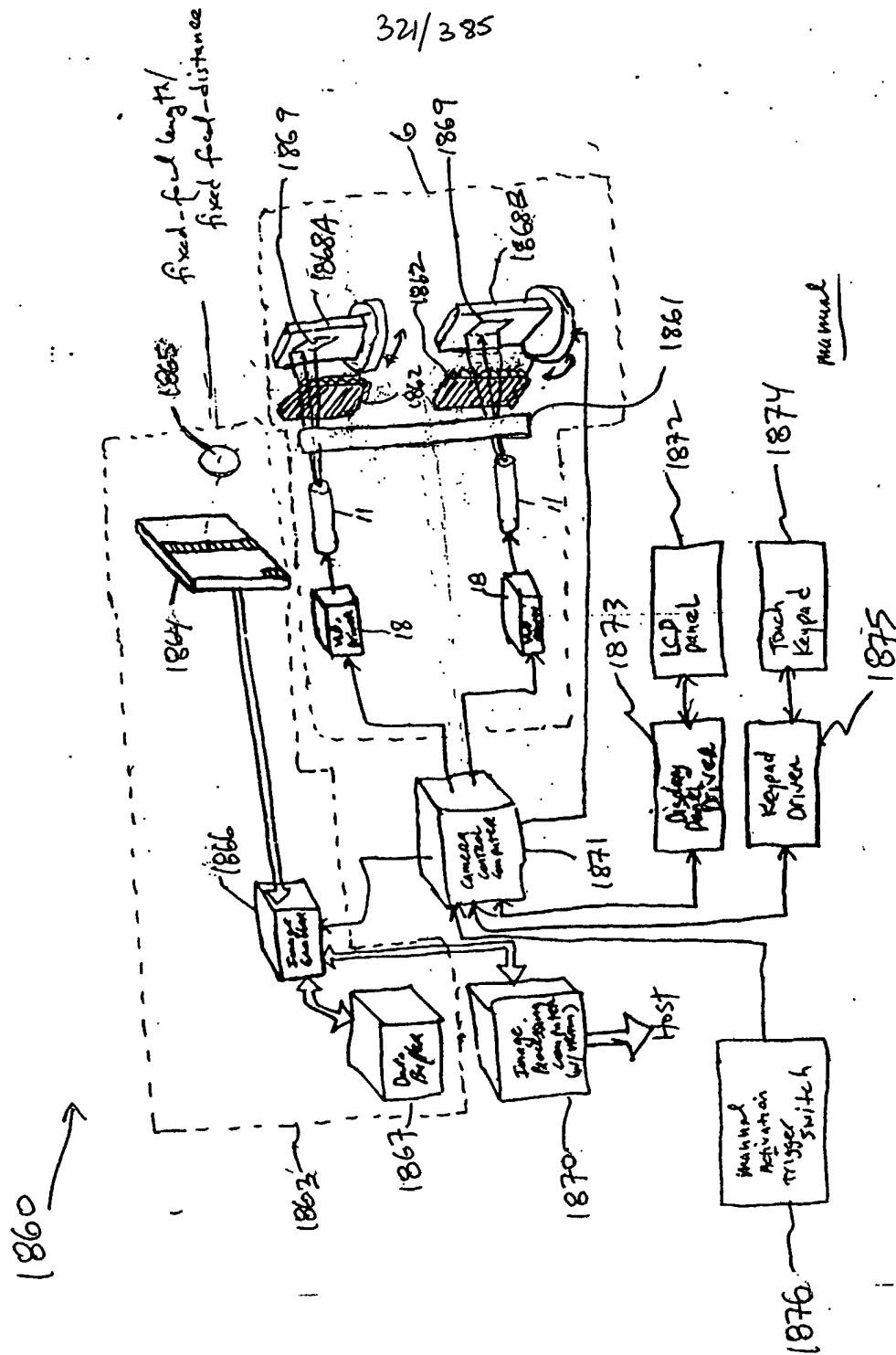
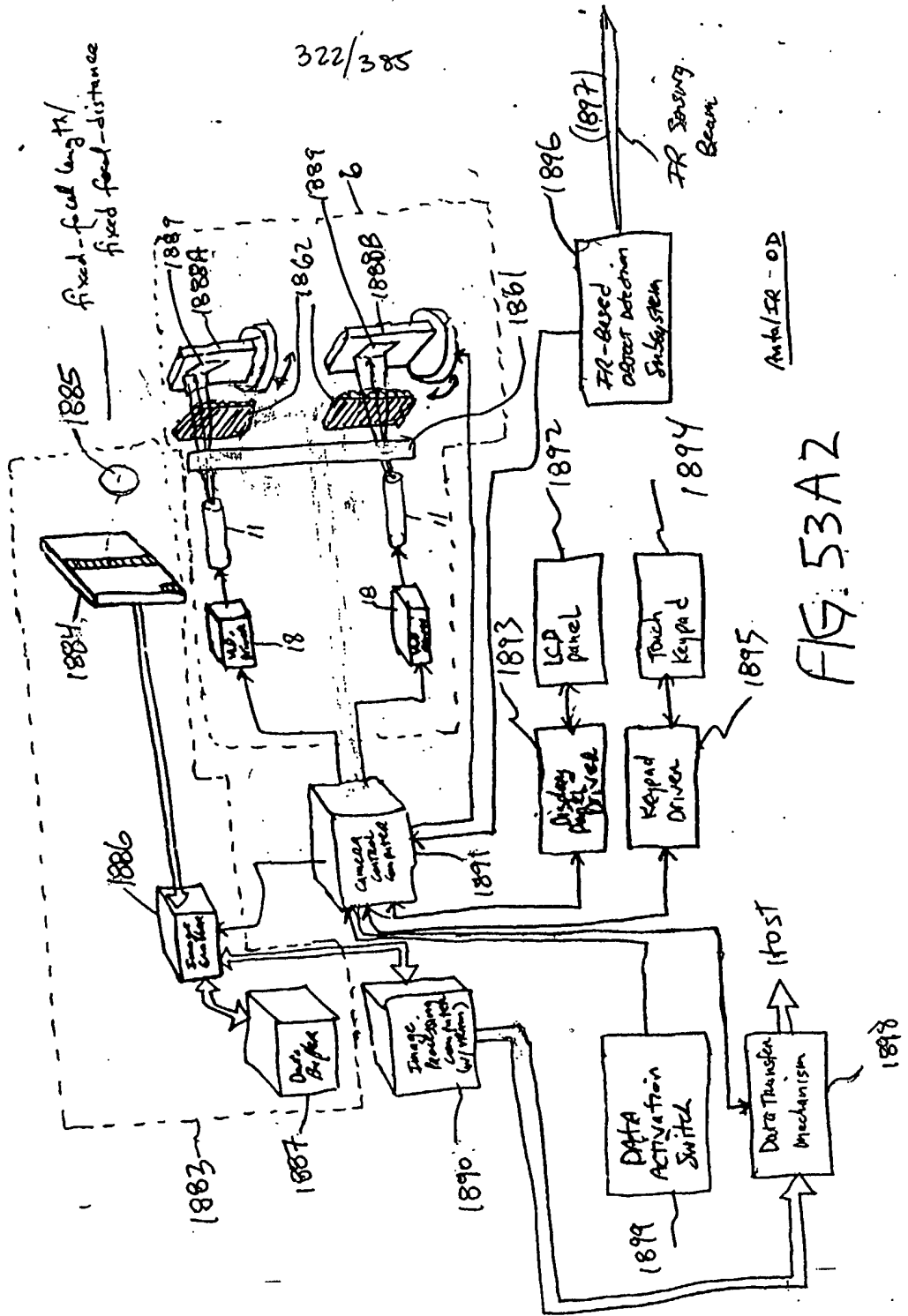


FIG. 53A1

1880



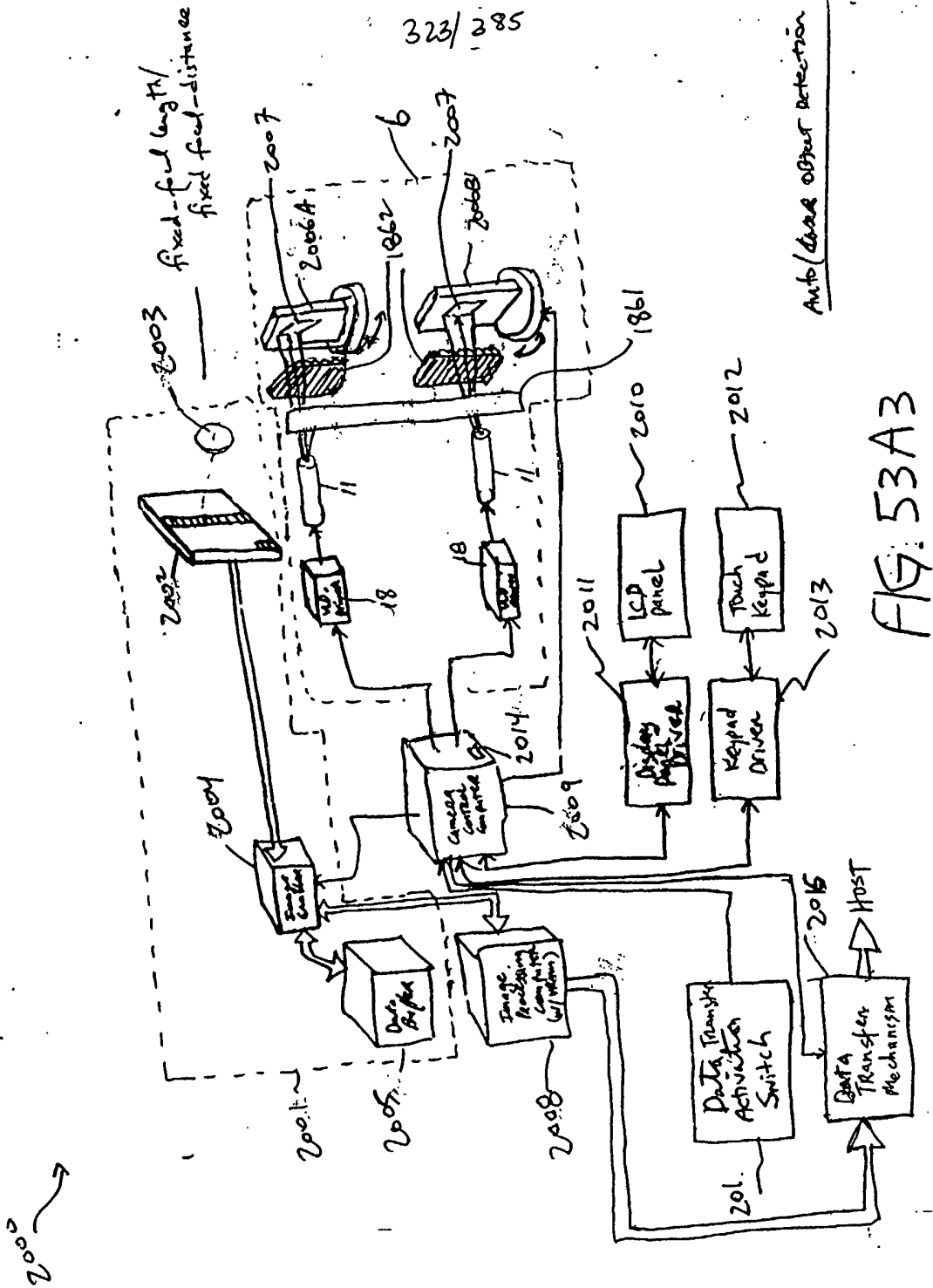
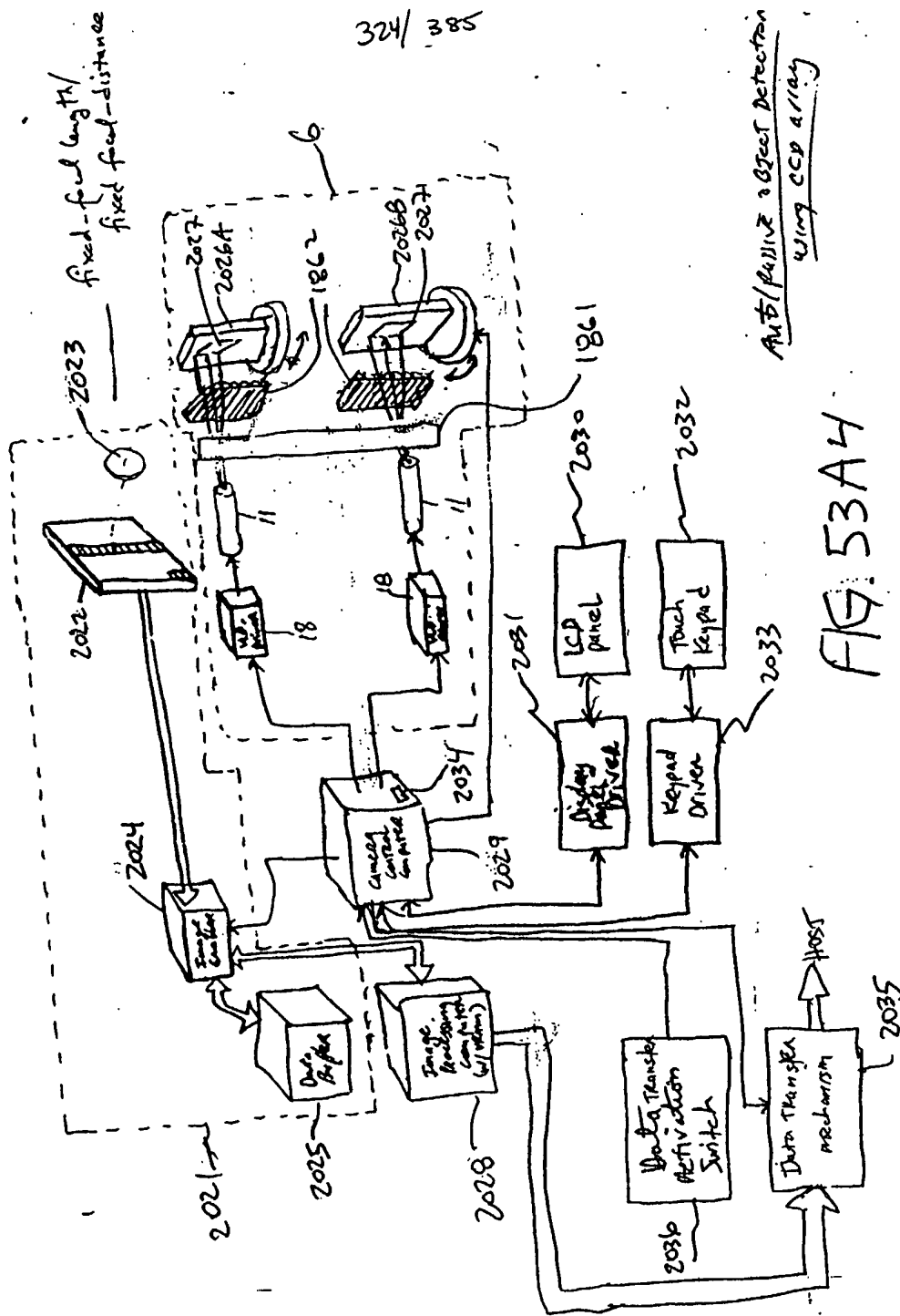


FIG. 53A3

## Auto/Class Object Detection



2020 →

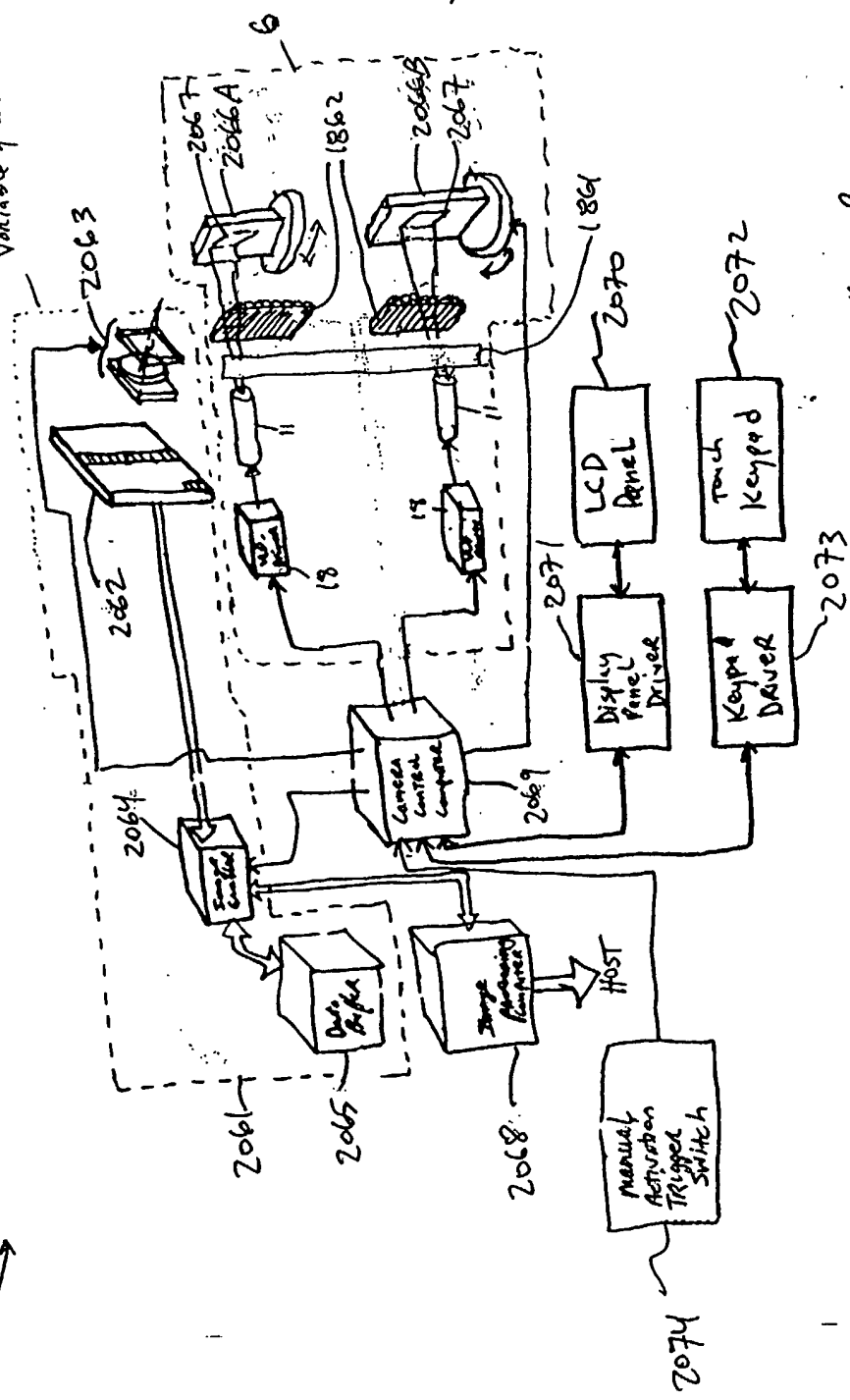




fixed focal length/  
variable focal distance

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2060 →



Manual

FIG. 53B1

2080

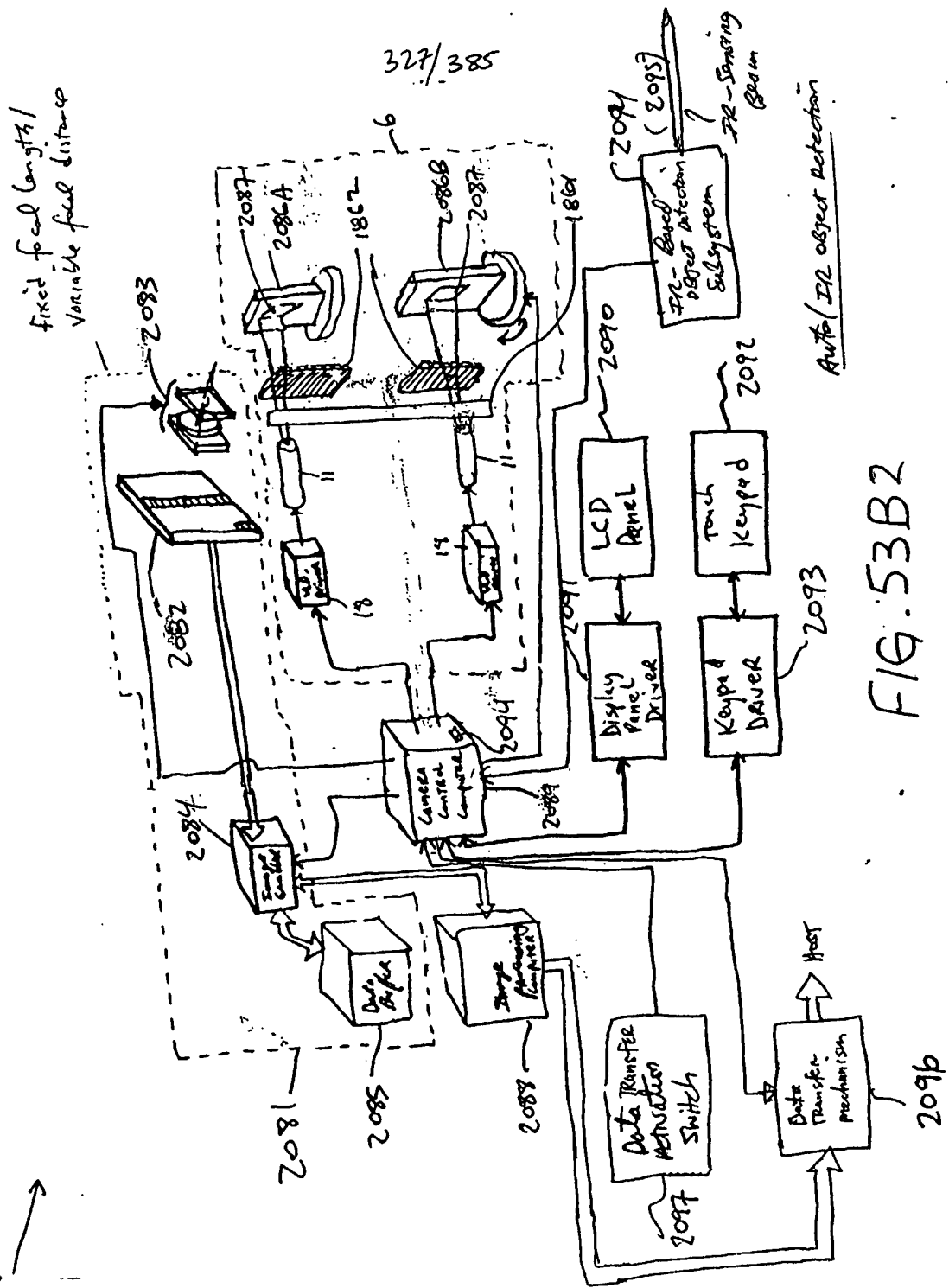
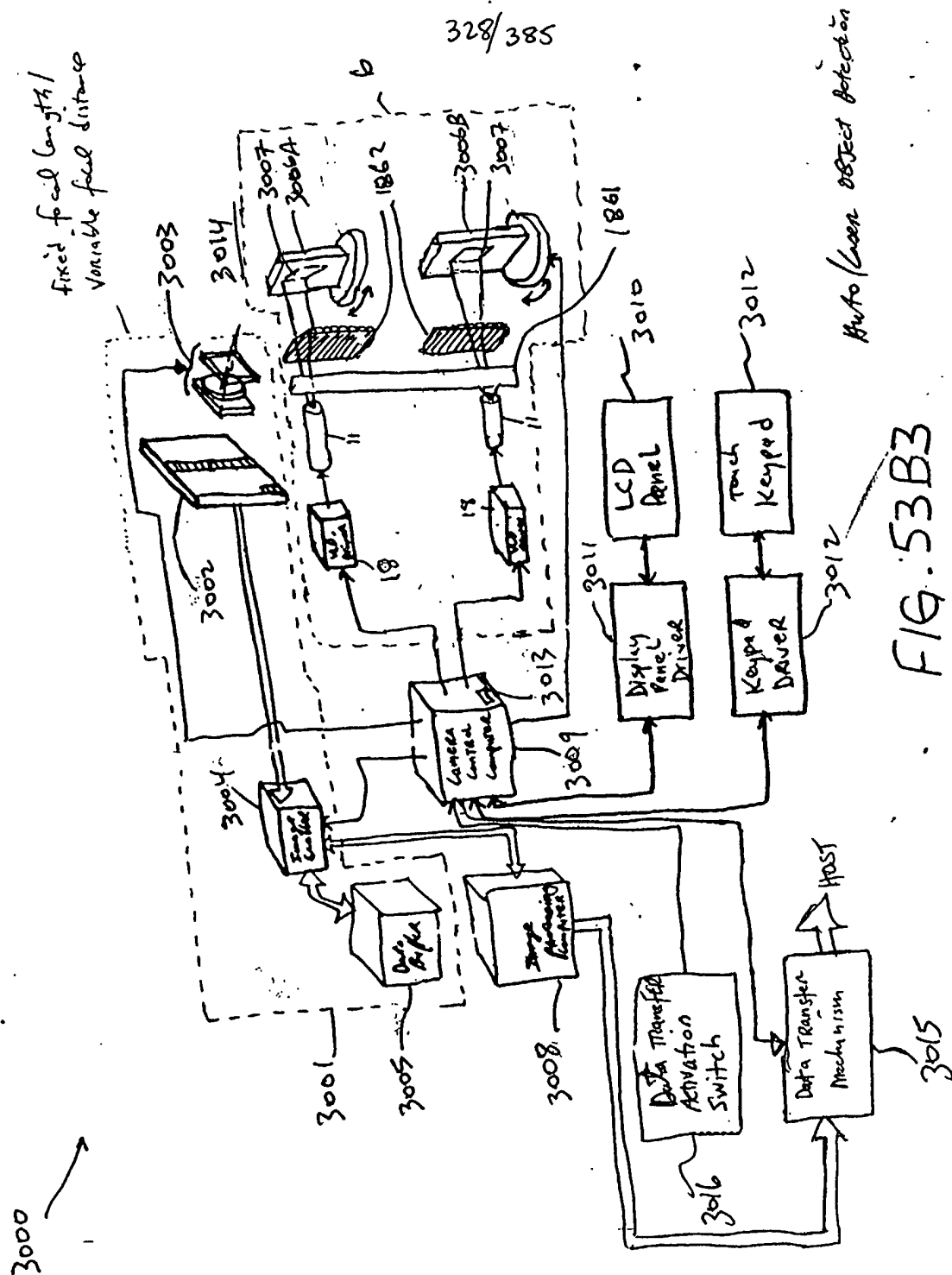
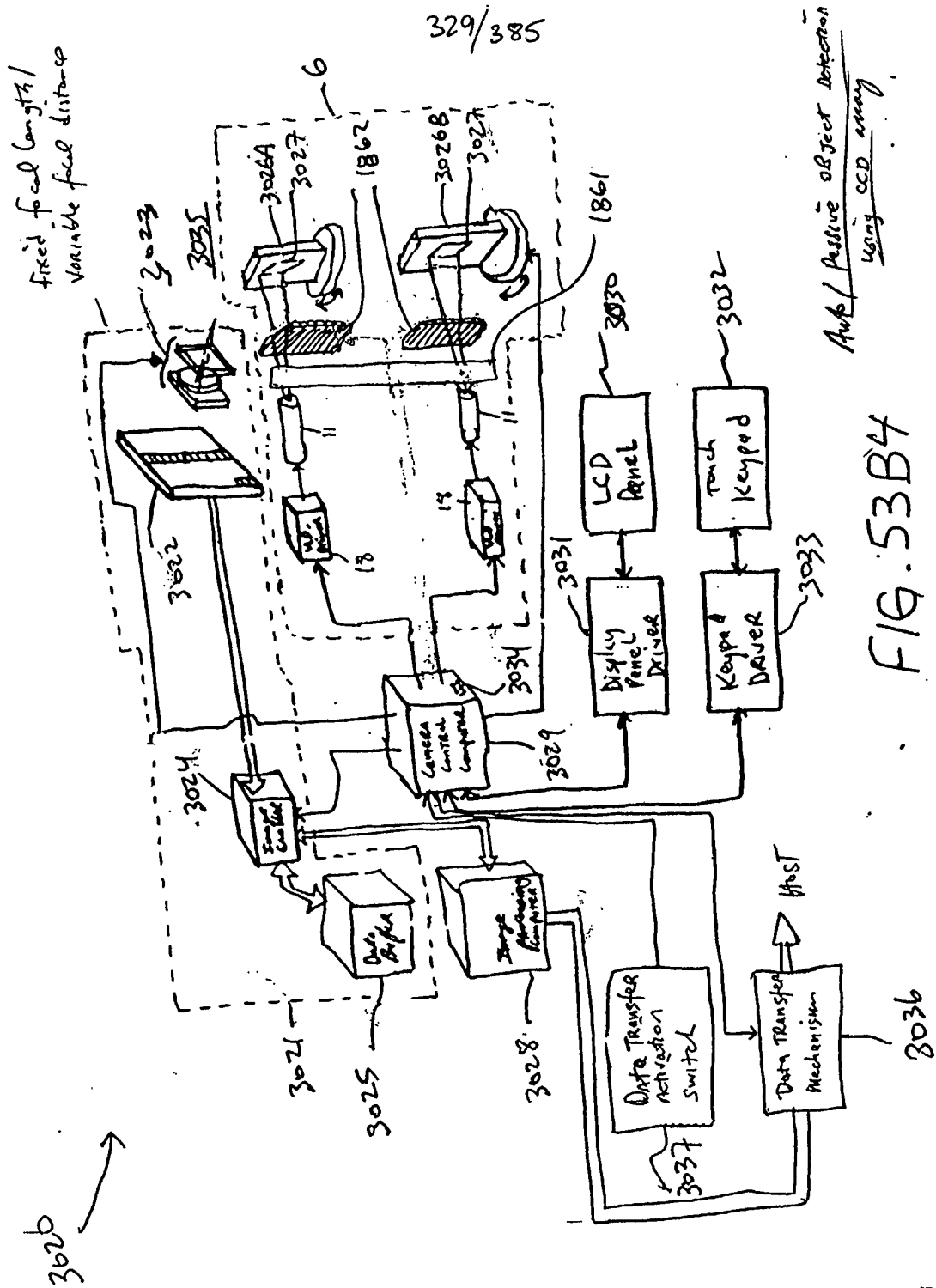


FIG. 53B2





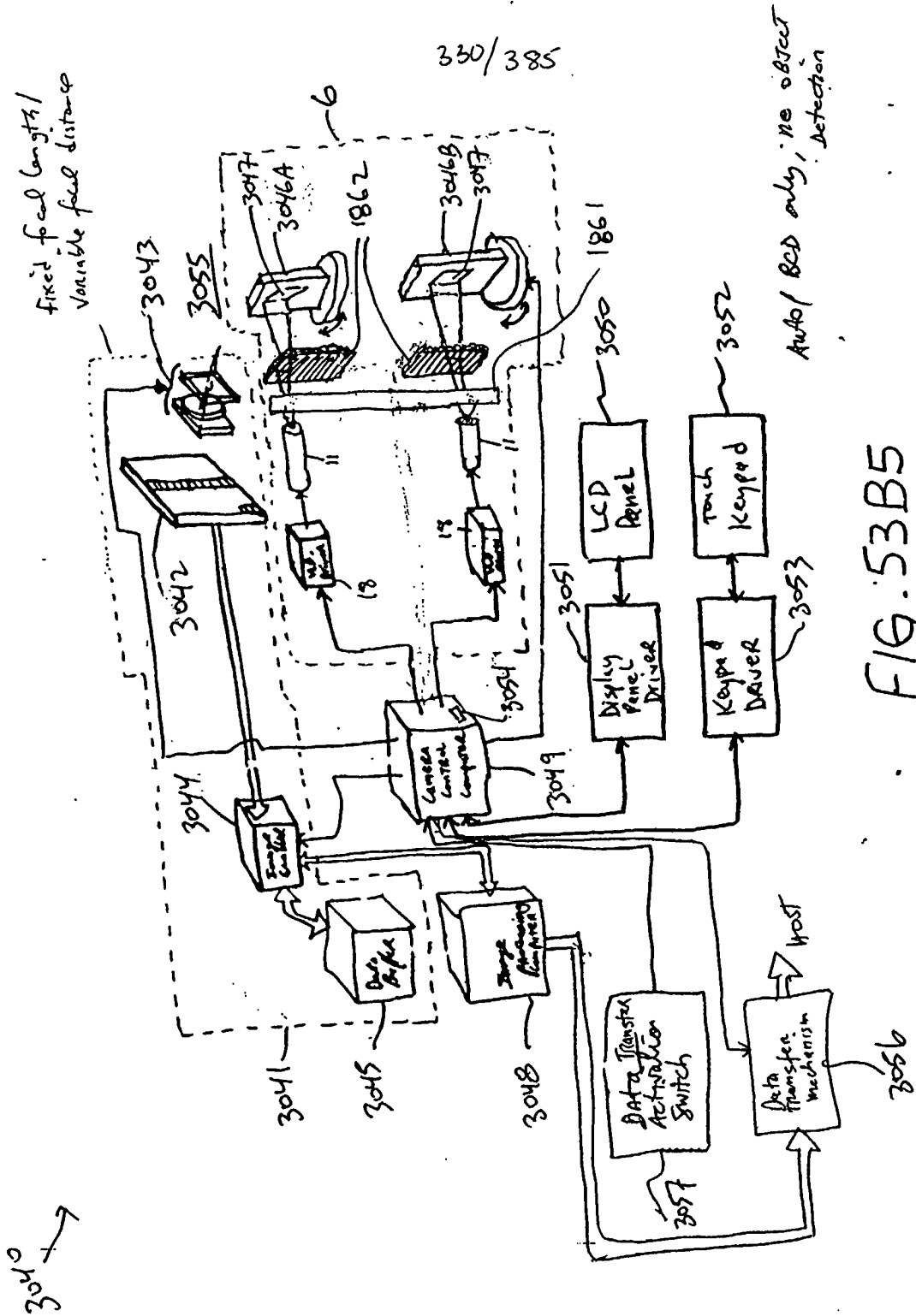
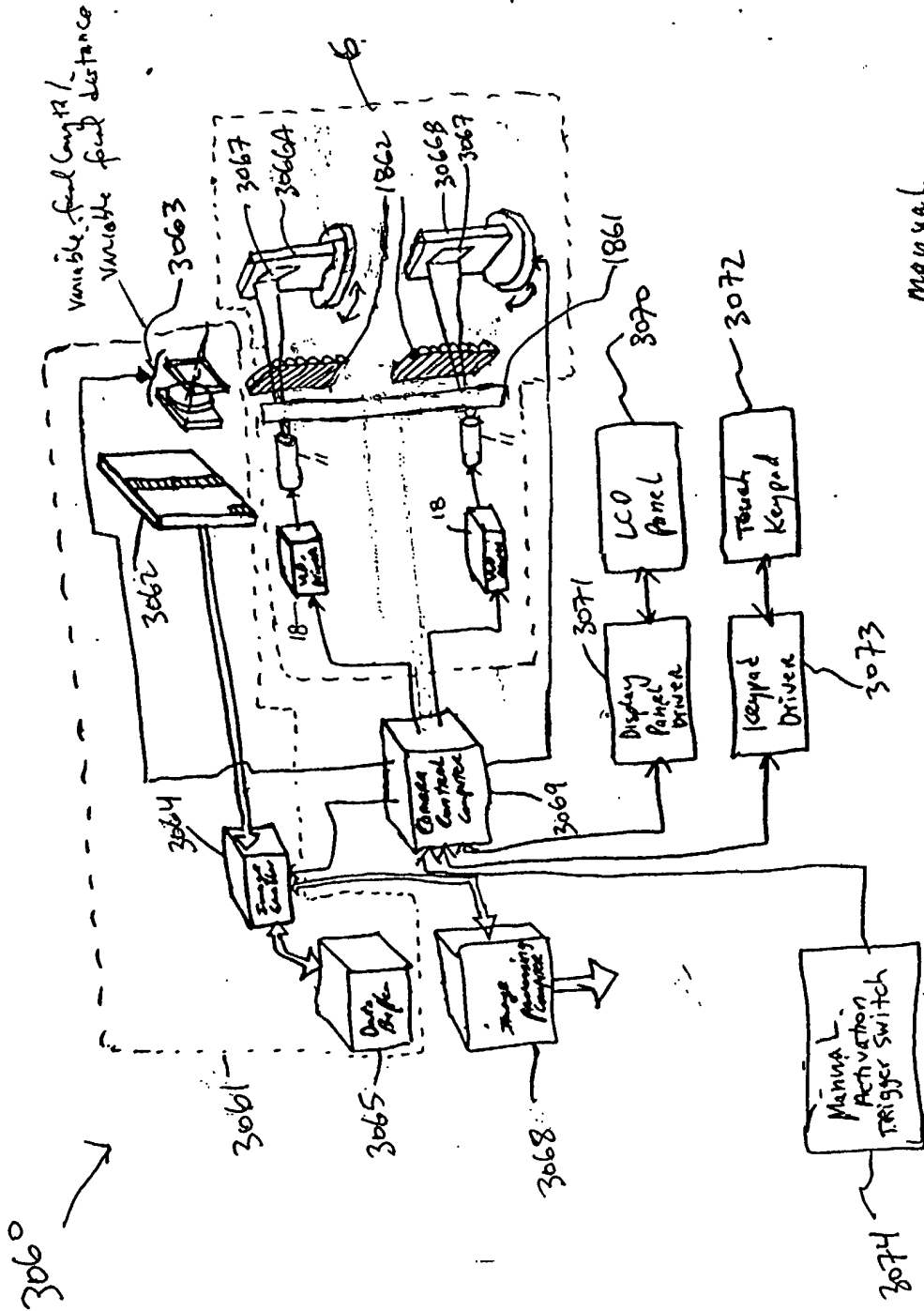


FIG. 53B5

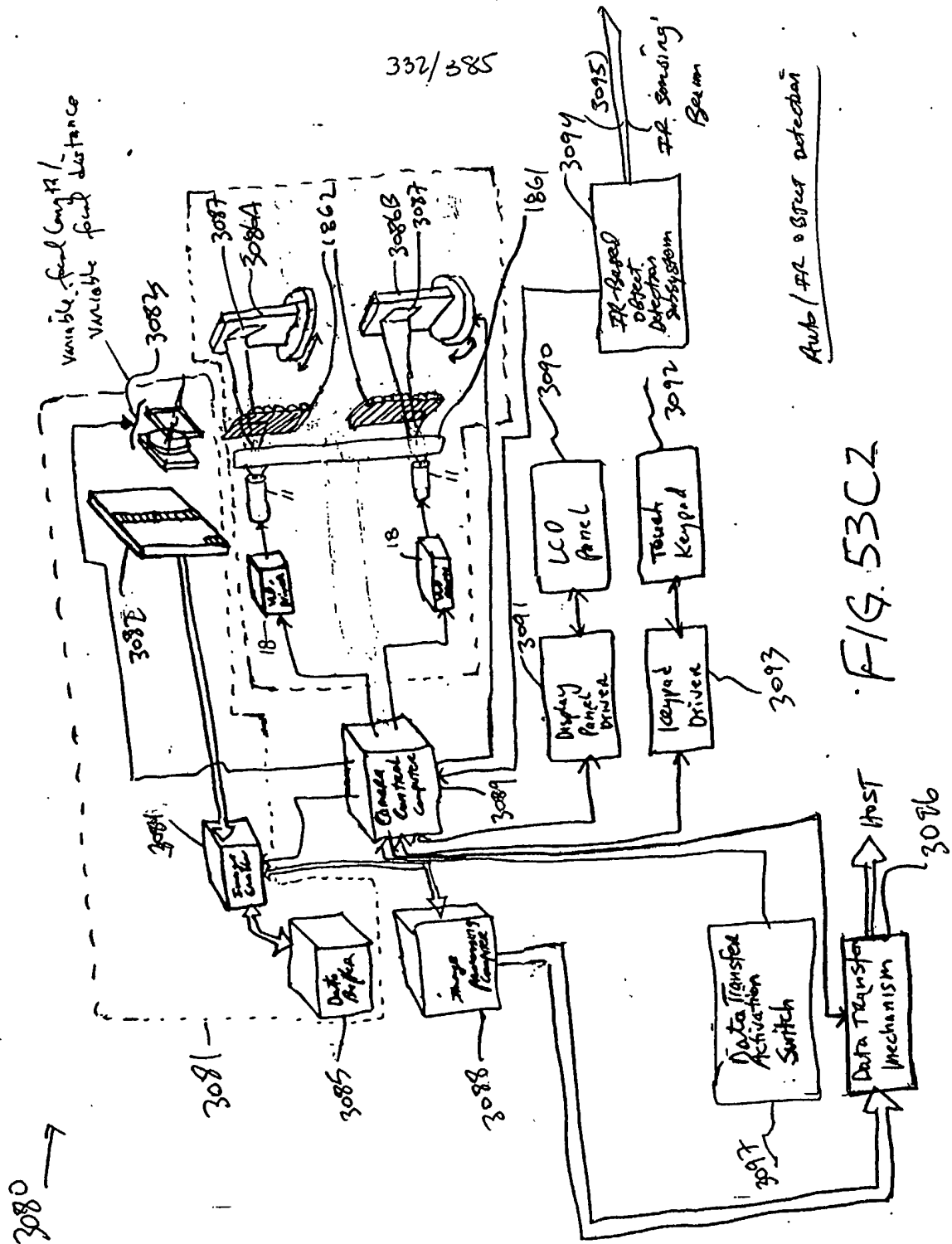
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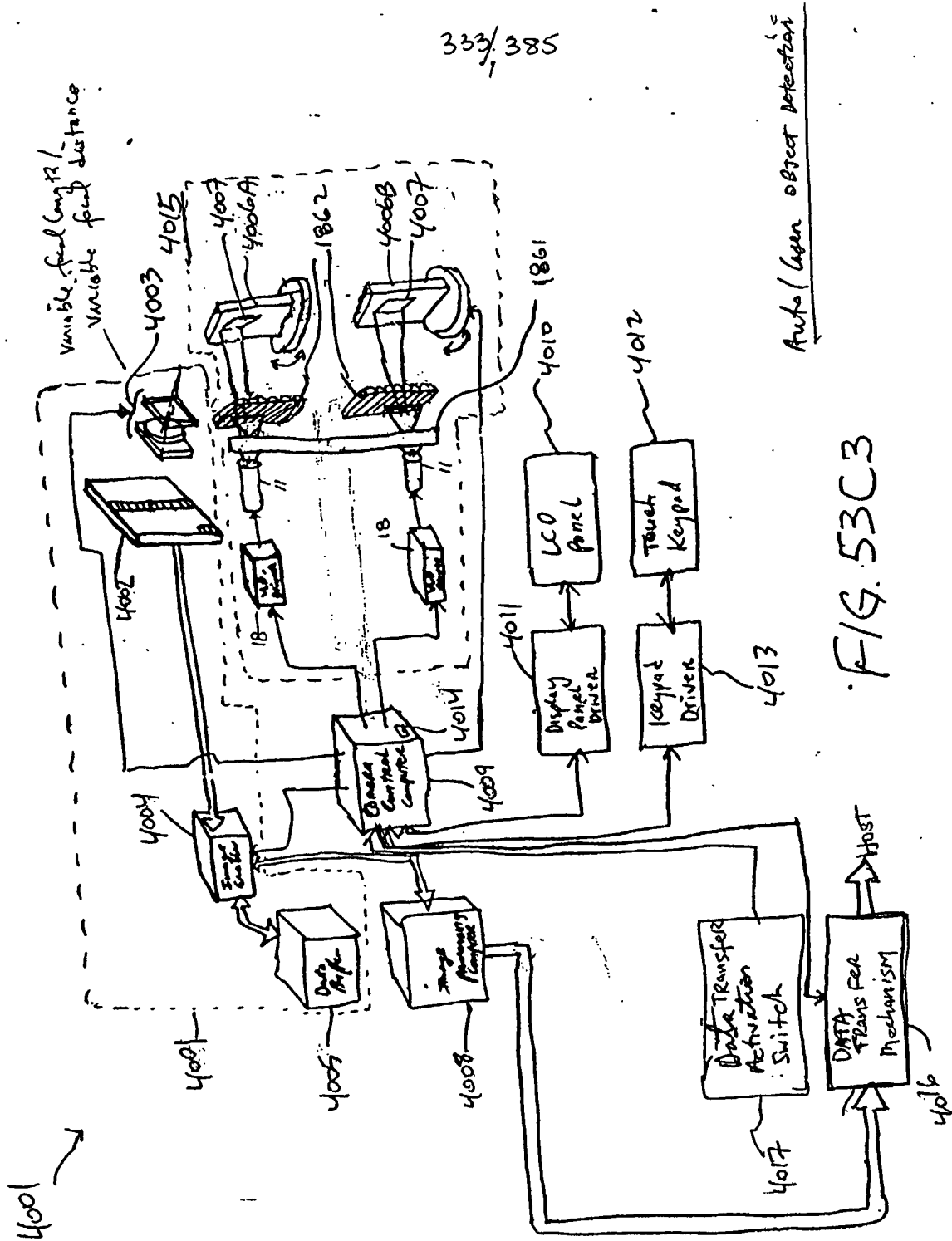


Manual

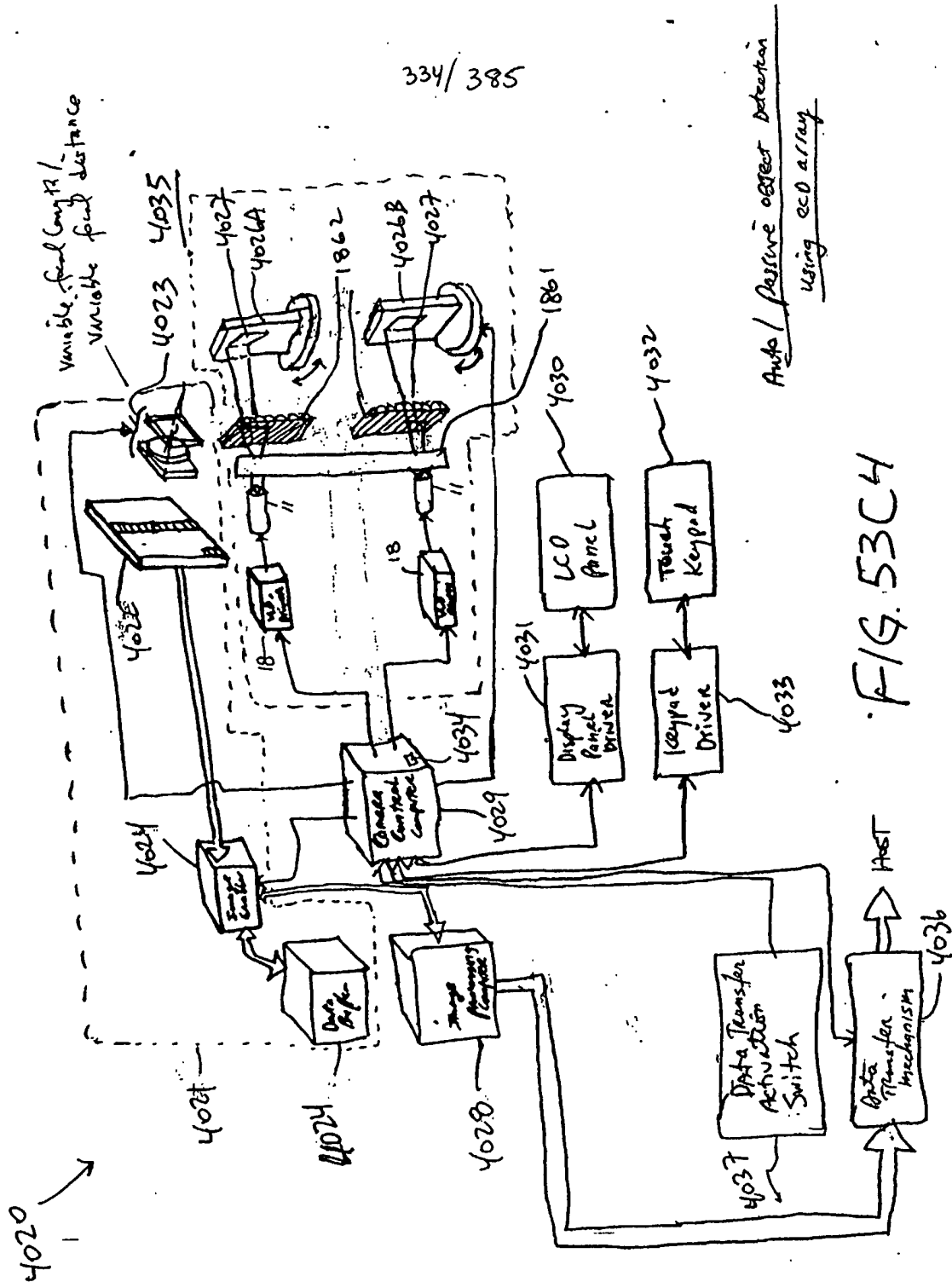
FIG. 53C1

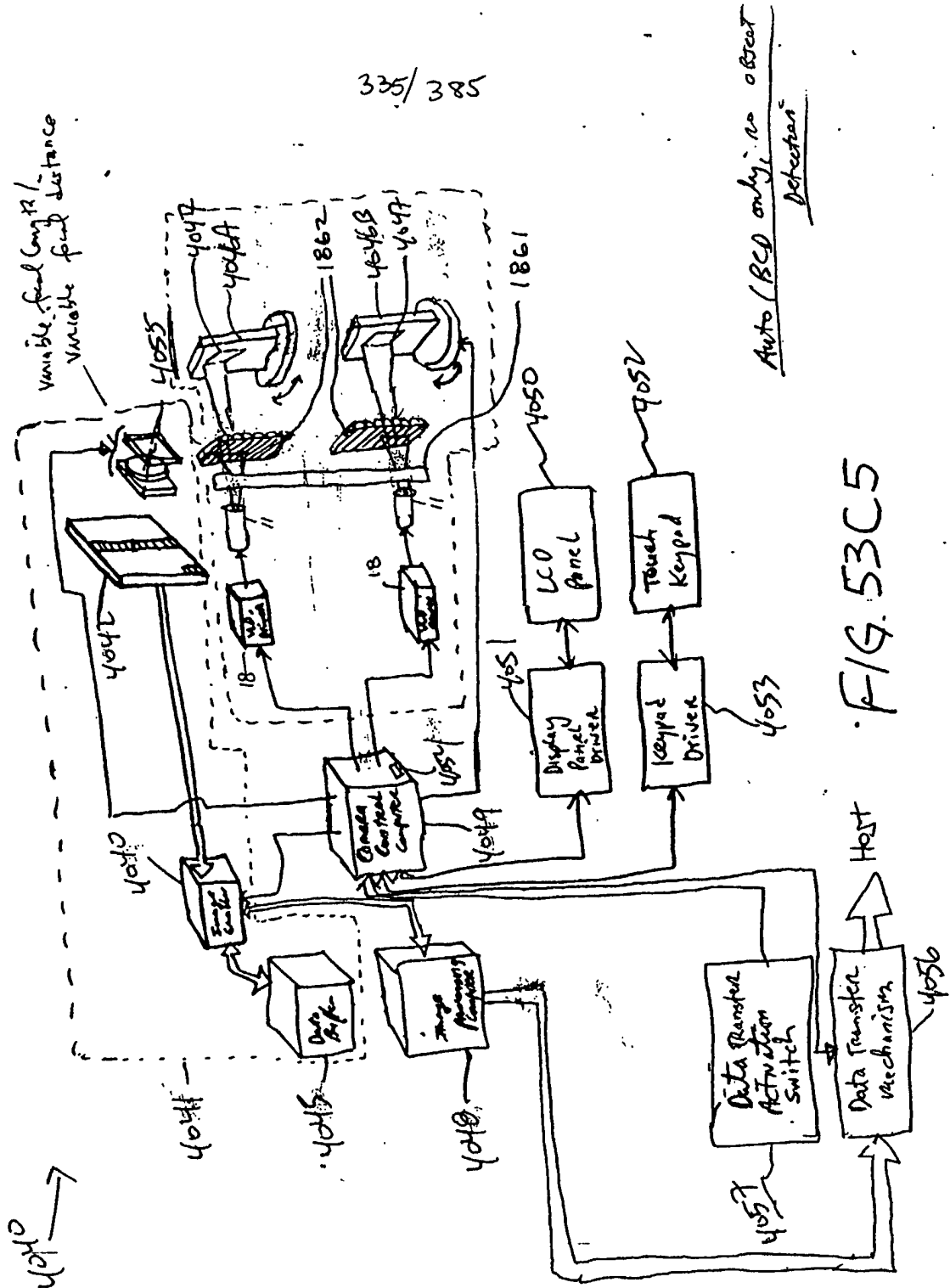






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Auto (BCD only): no object  
detection

FIG. 53C5

1504

4056

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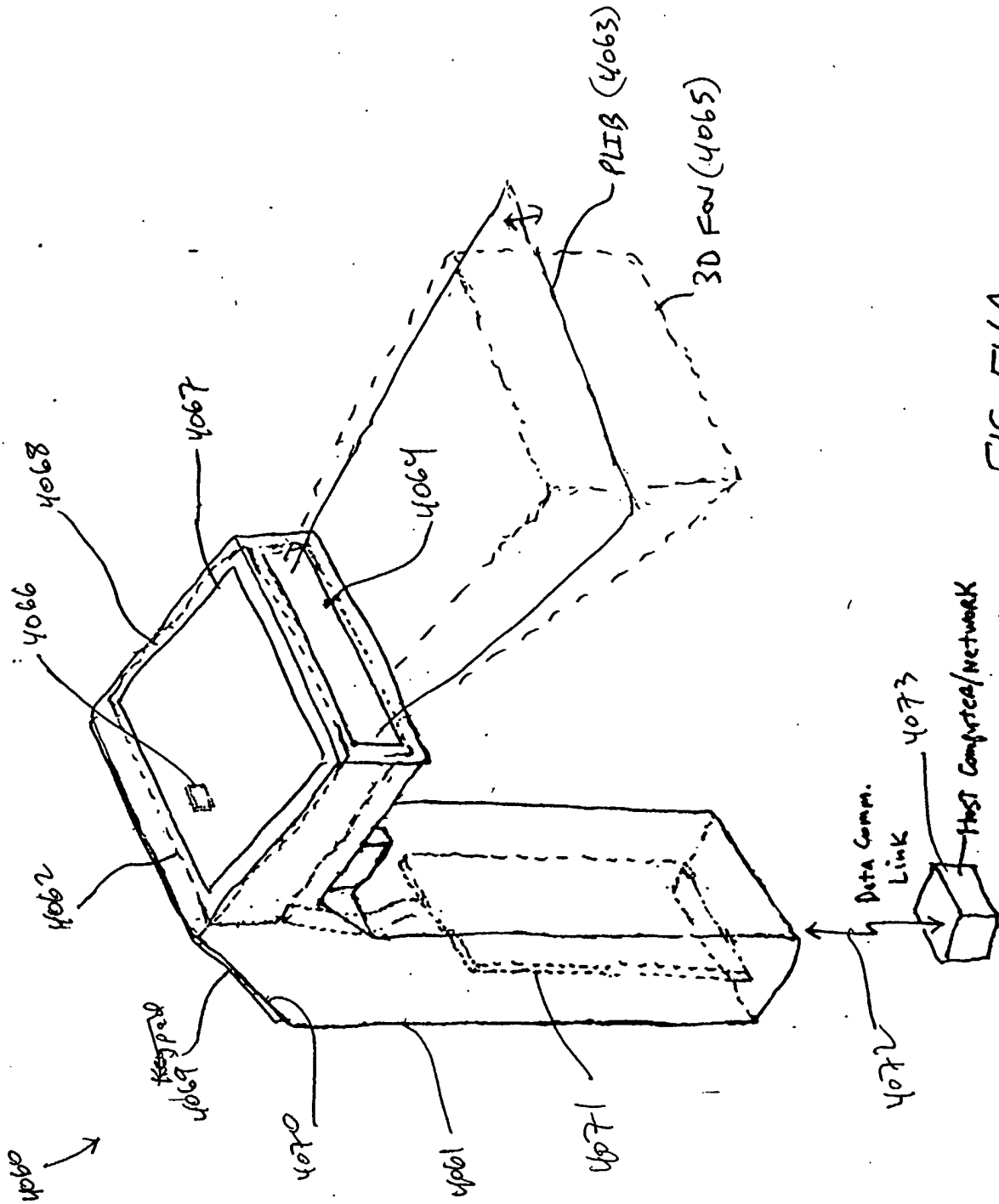


FIG. 54A

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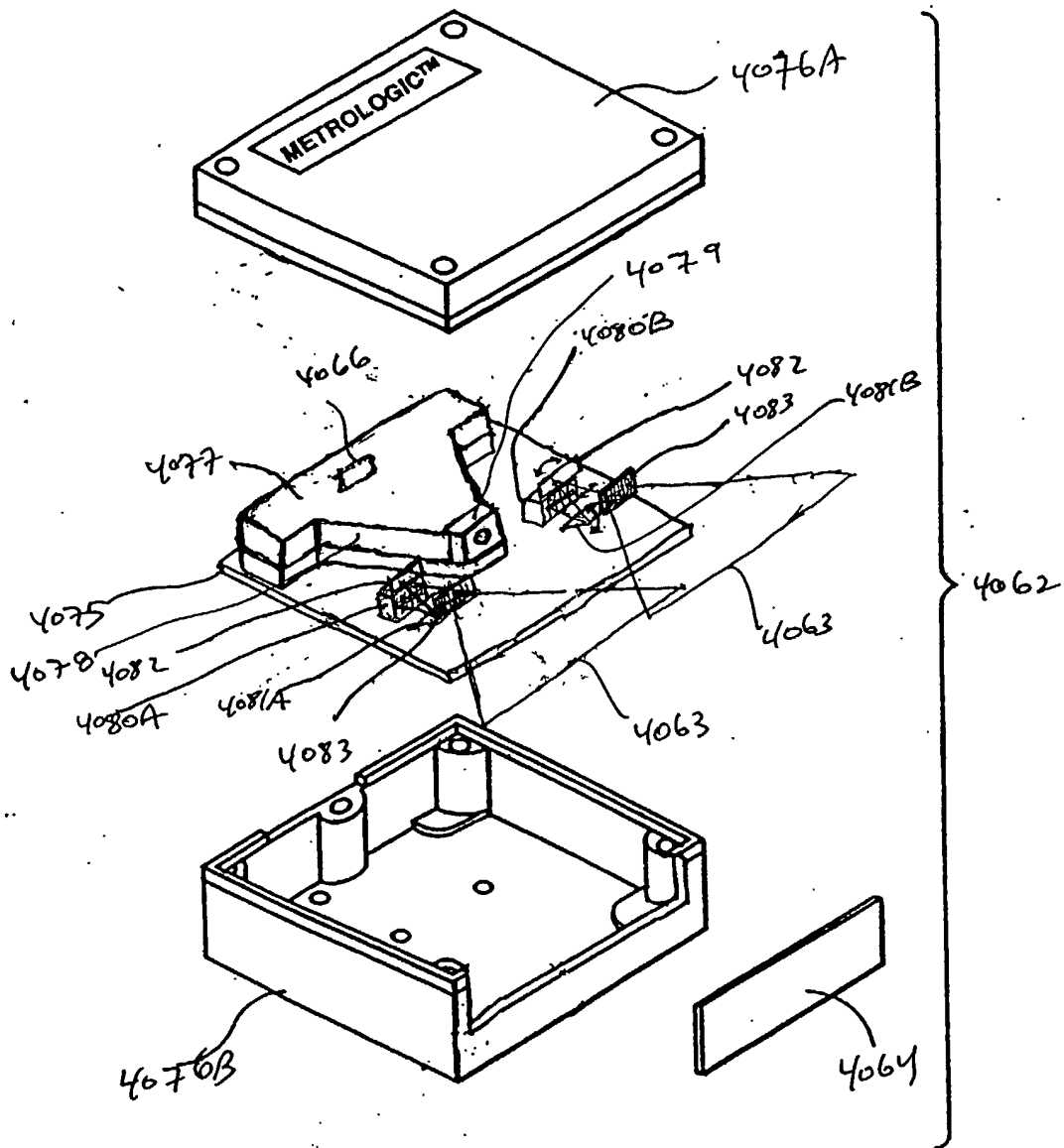


FIG. 54B

(Dual mirrors)

Fig. 1F5A-SP1

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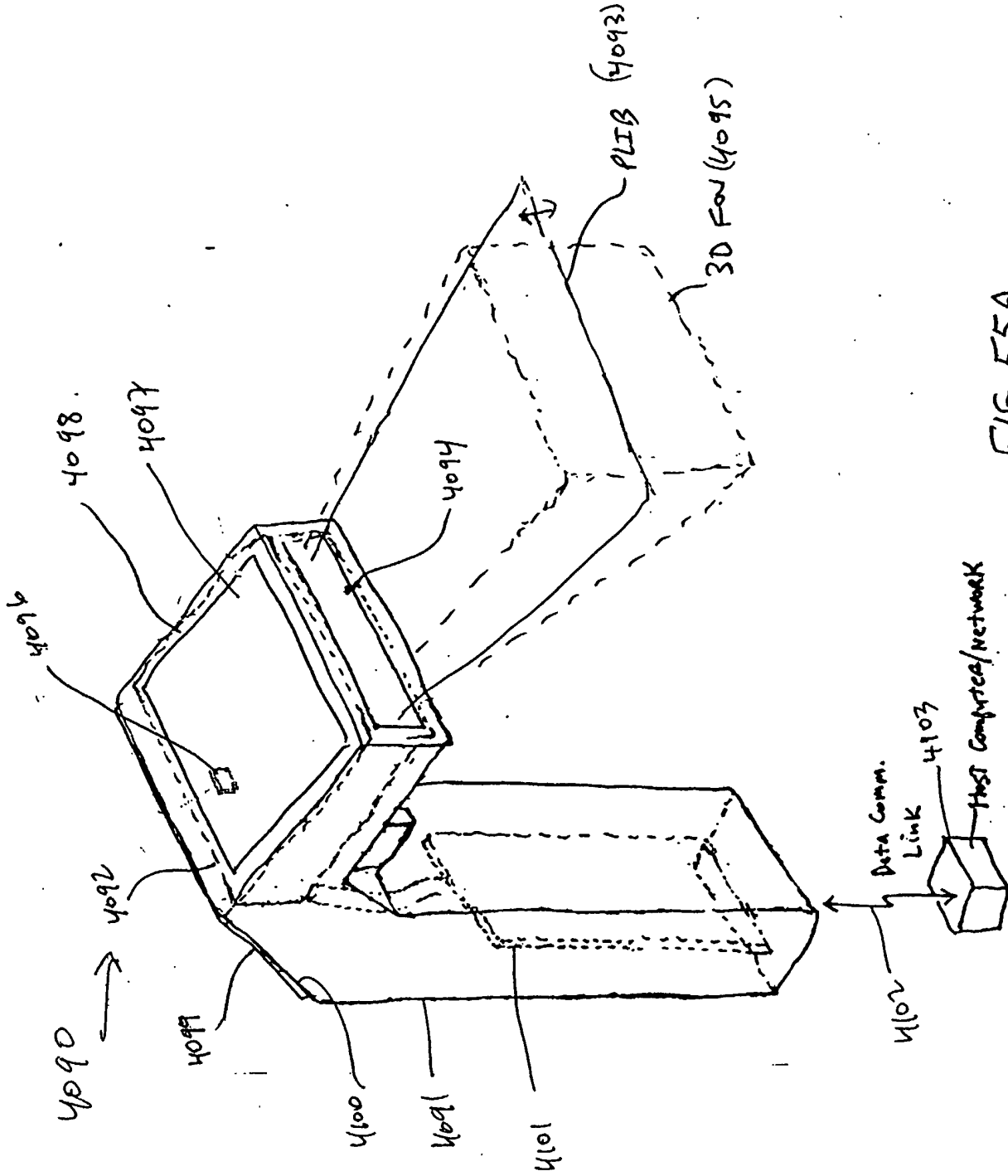
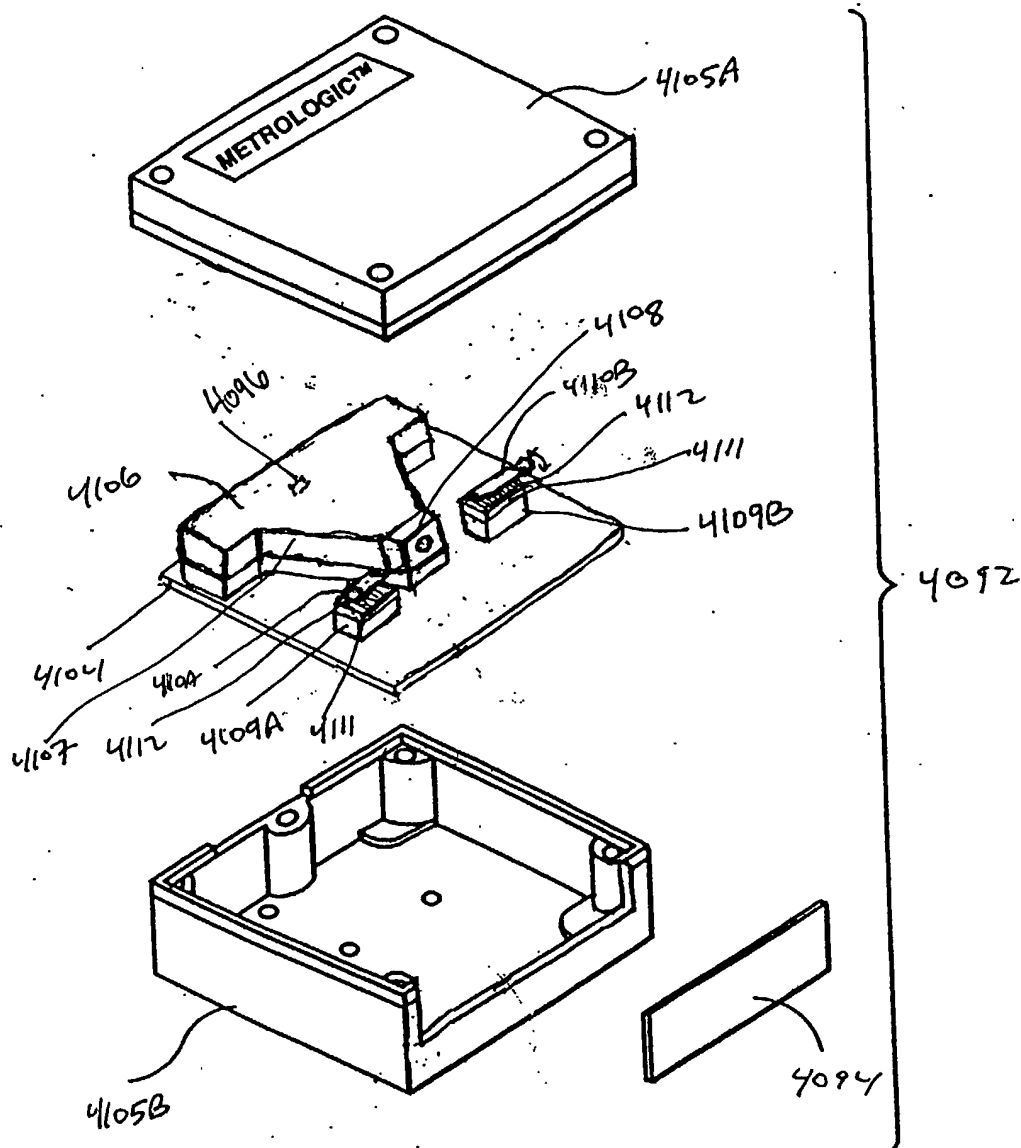


FIG. 55A

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- FIG. 55B

Brogg cell -  
Fig. 116A-6B



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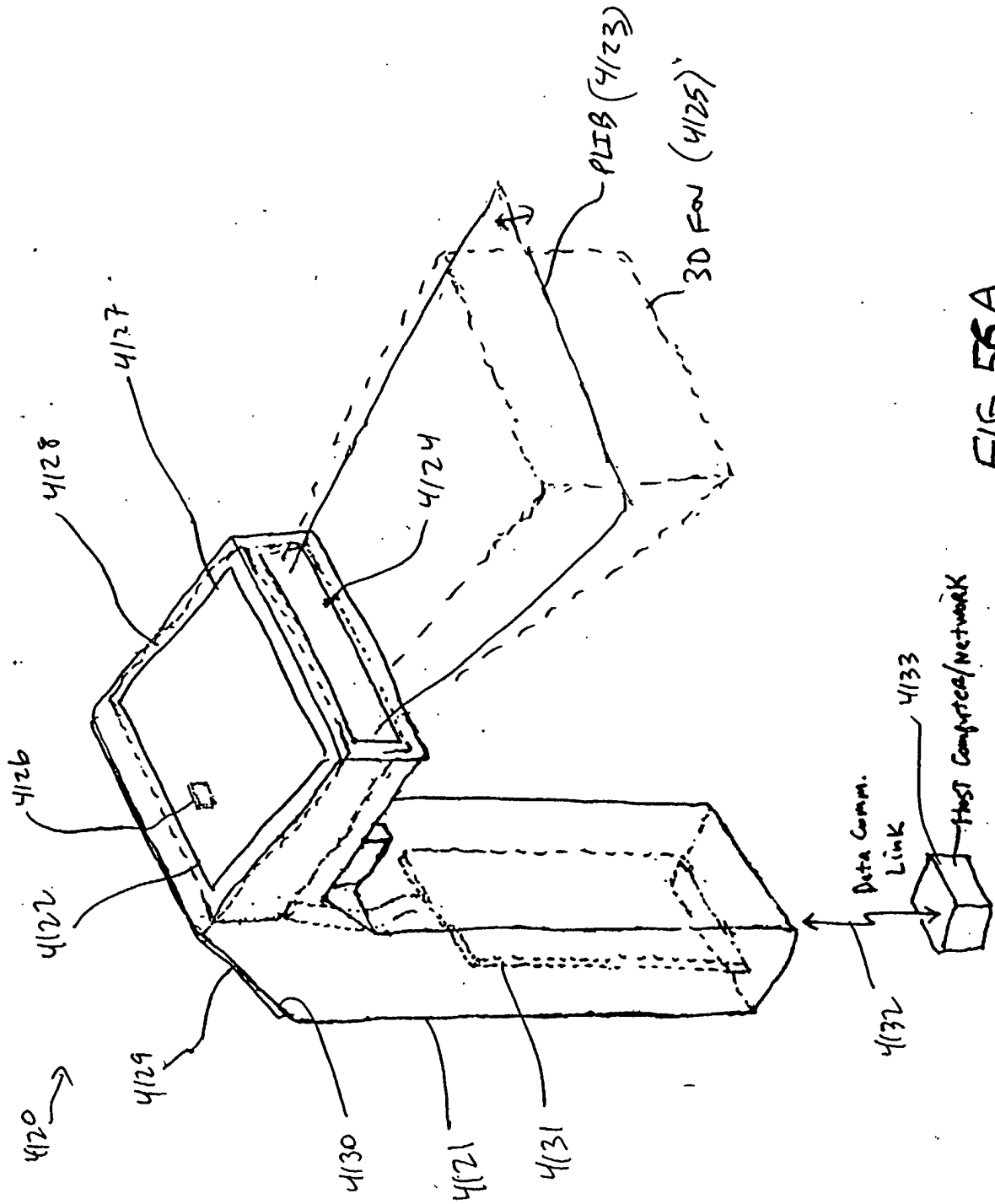


FIG. 56A

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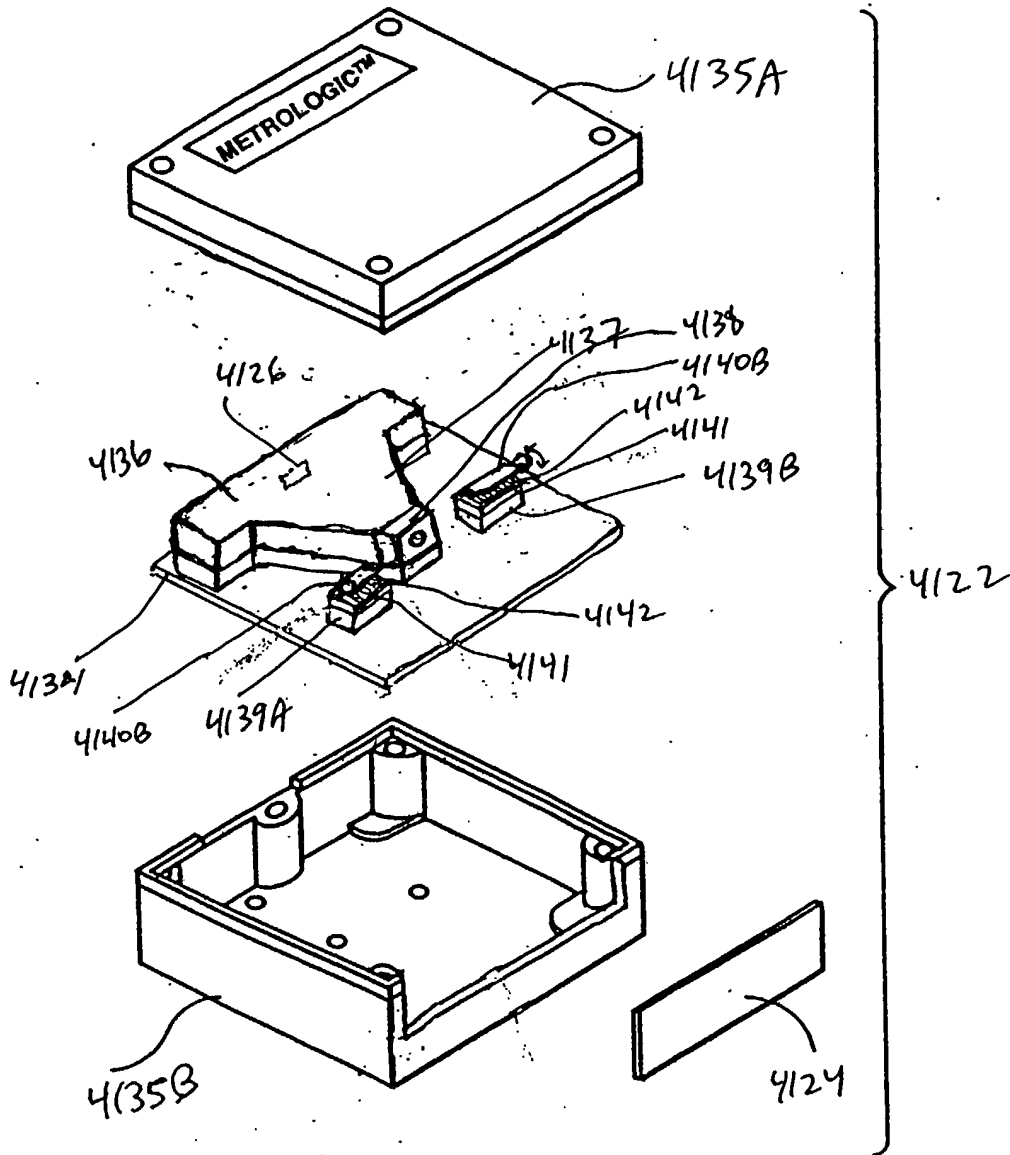


FIG. 56B

DM

Fig. 1I 7A-7C

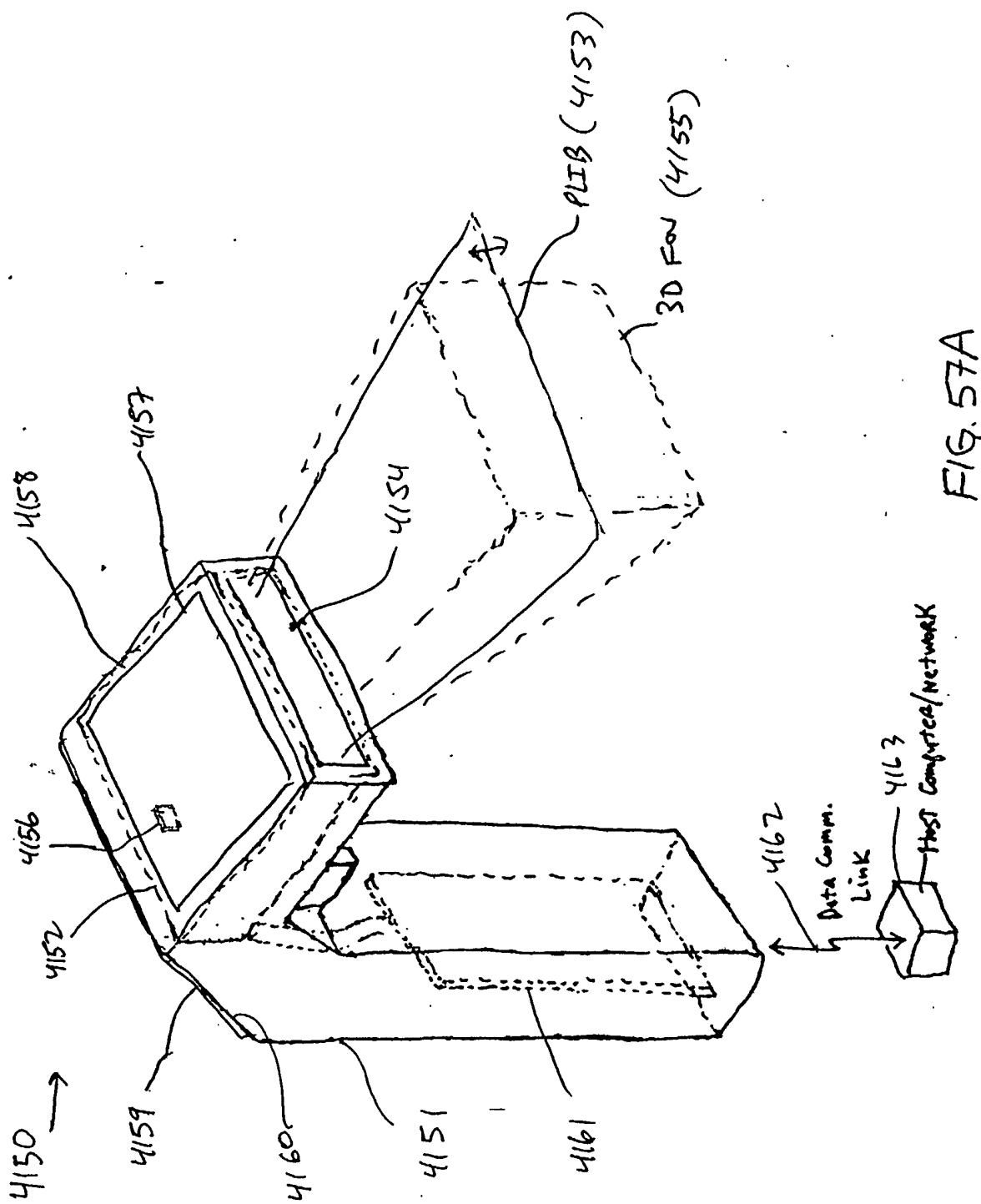


FIG. 57A

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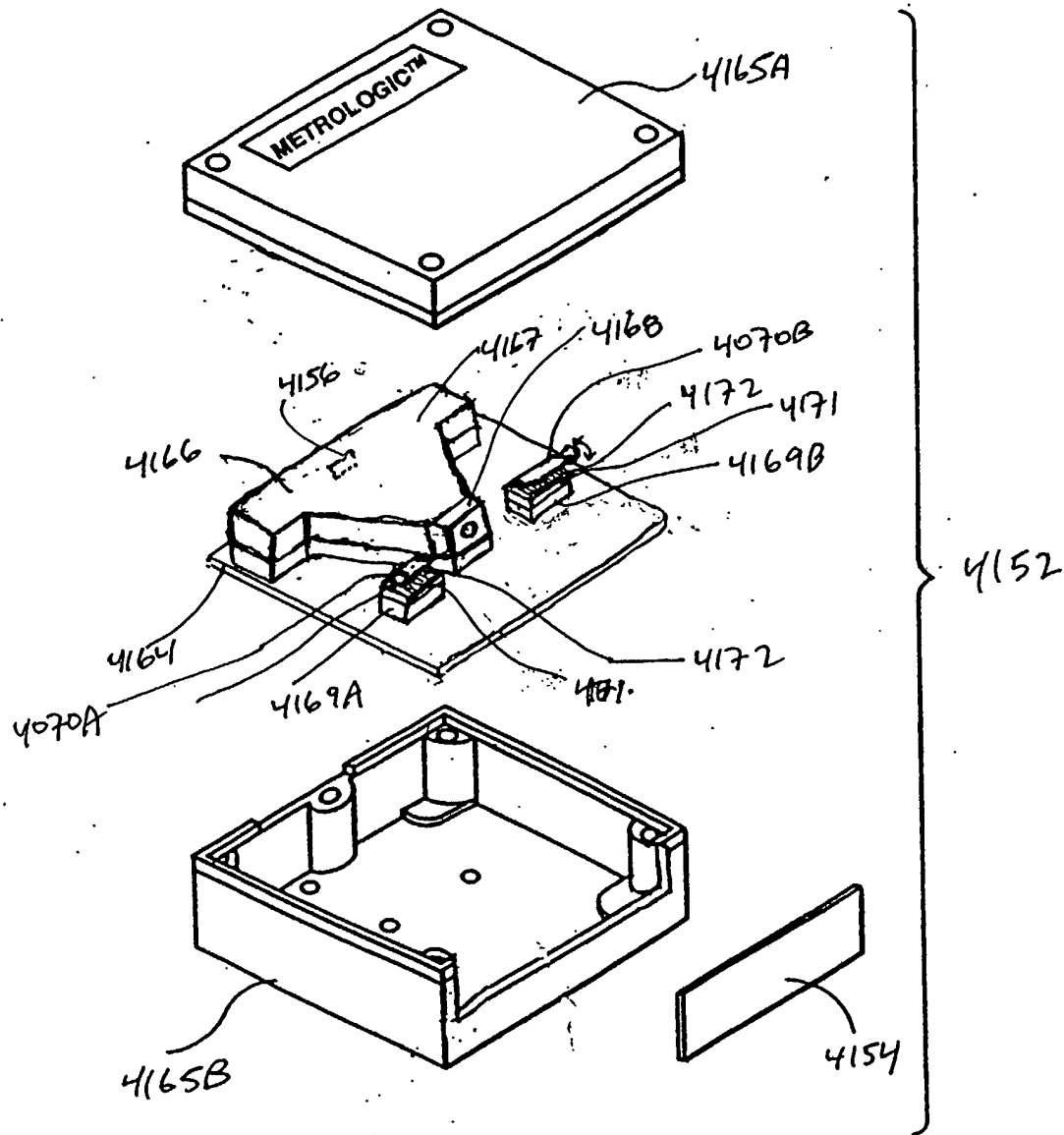


FIG. 57B

Phase only LCR  
PM panel

Figs 1F8F-8G

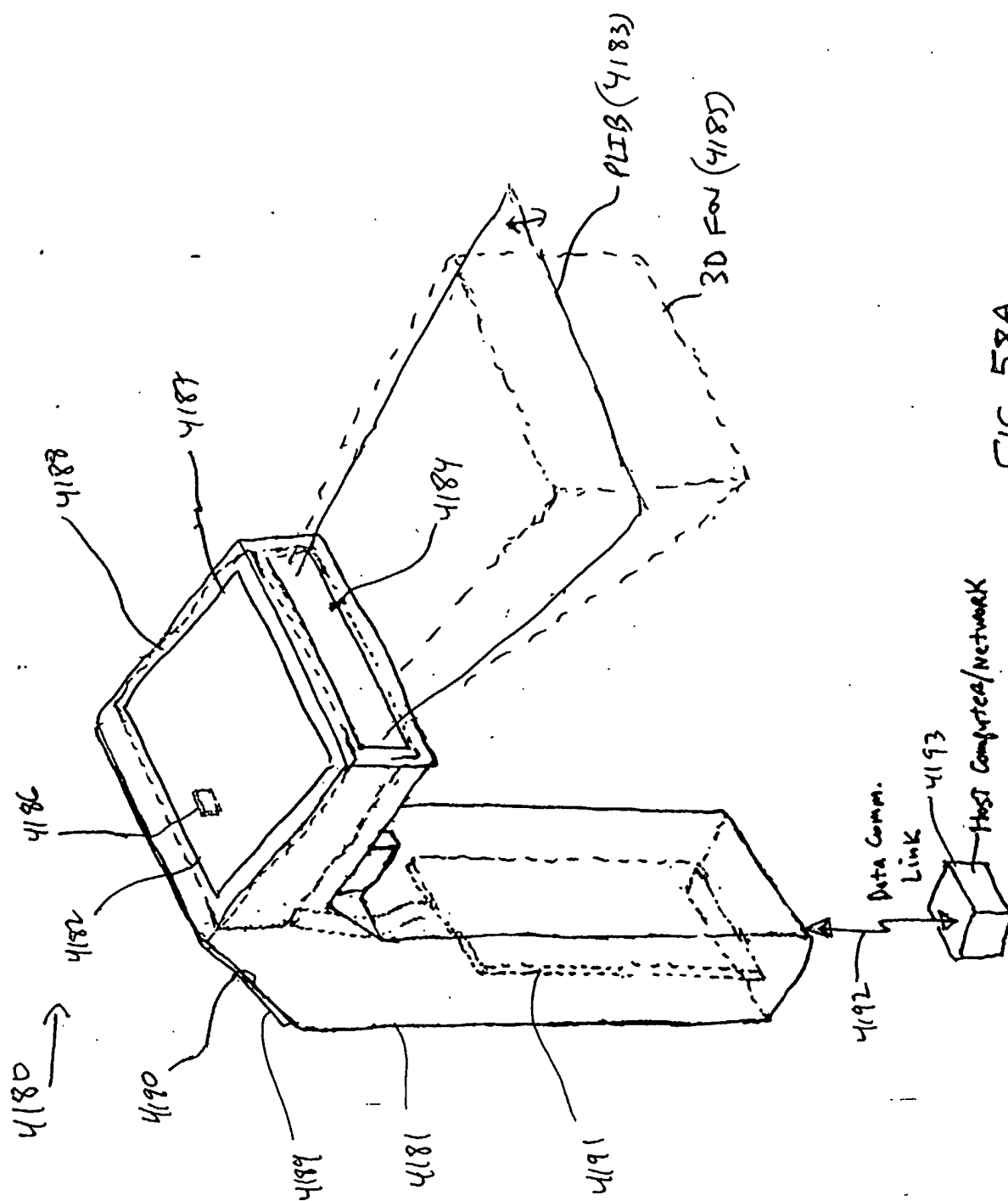


FIG. 58A

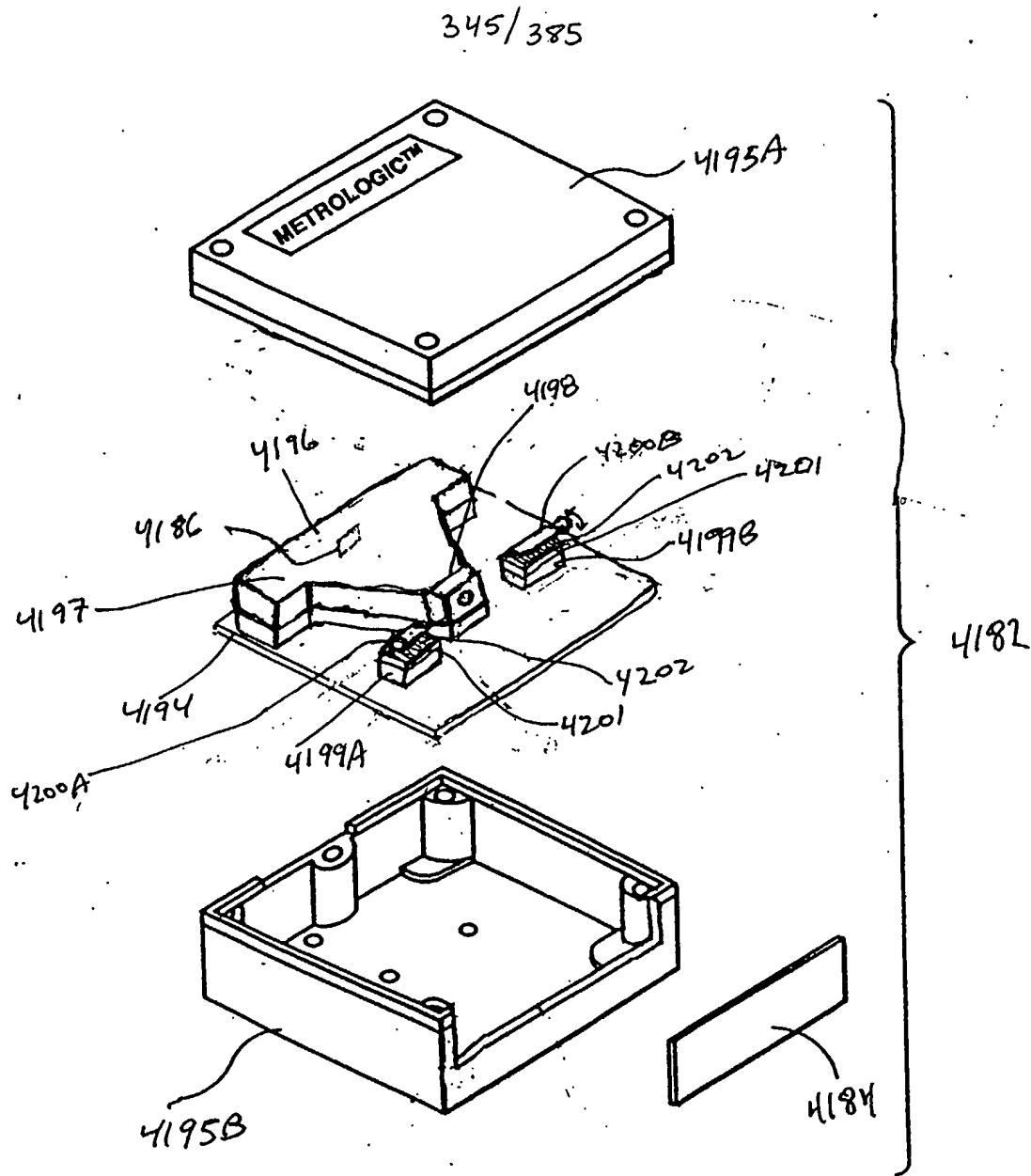


FIG. 58B

HS optical shield  
Fig. 1714A-14B

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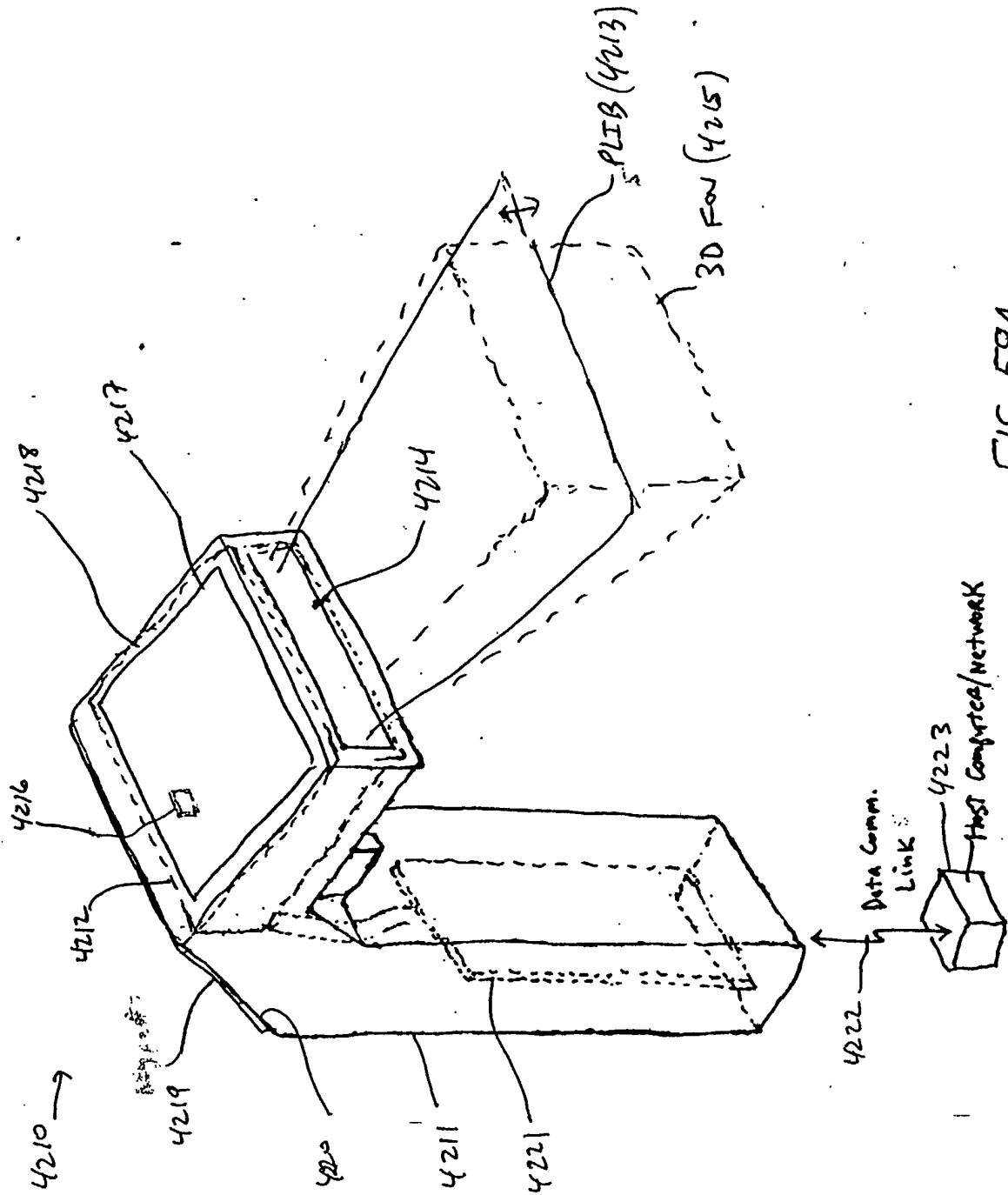


FIG. 59A

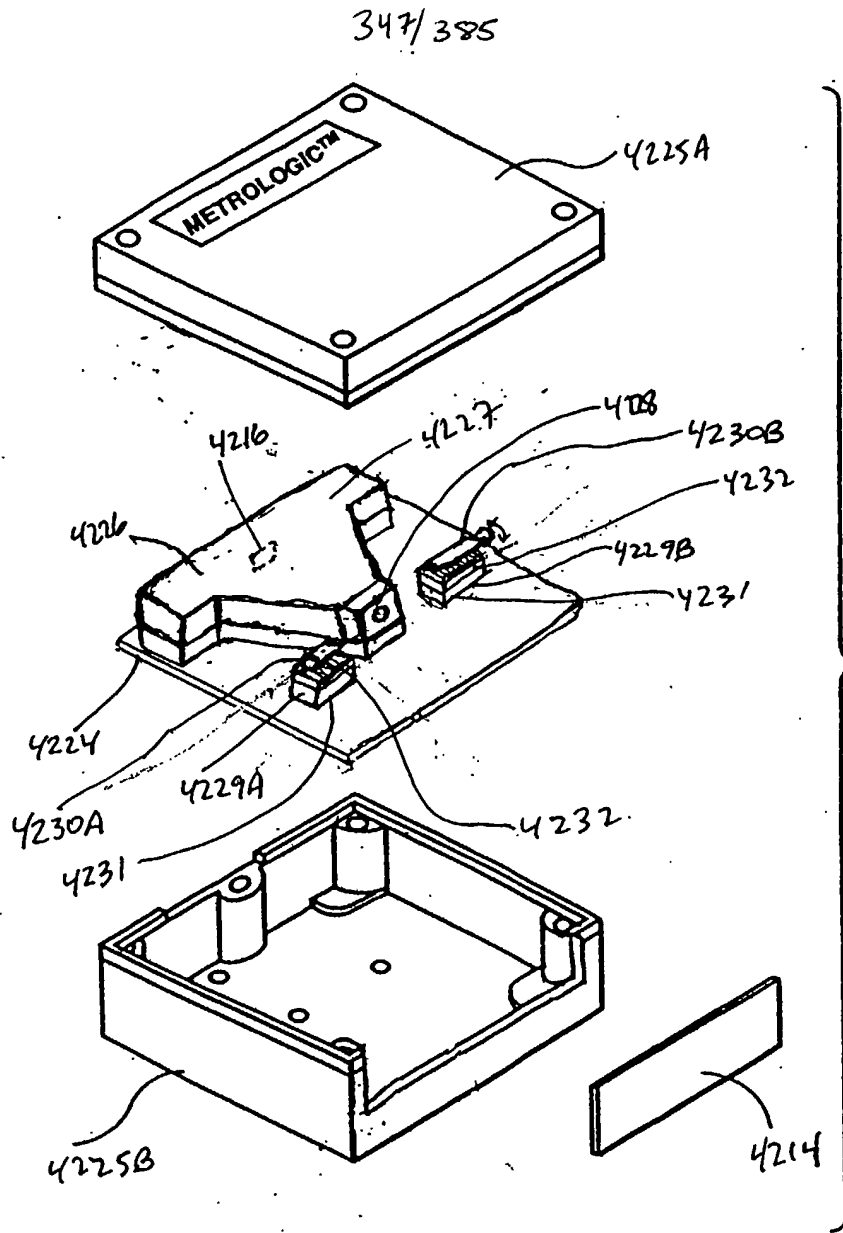


FIG. 59B

MLD  
Fig. 15A-15B



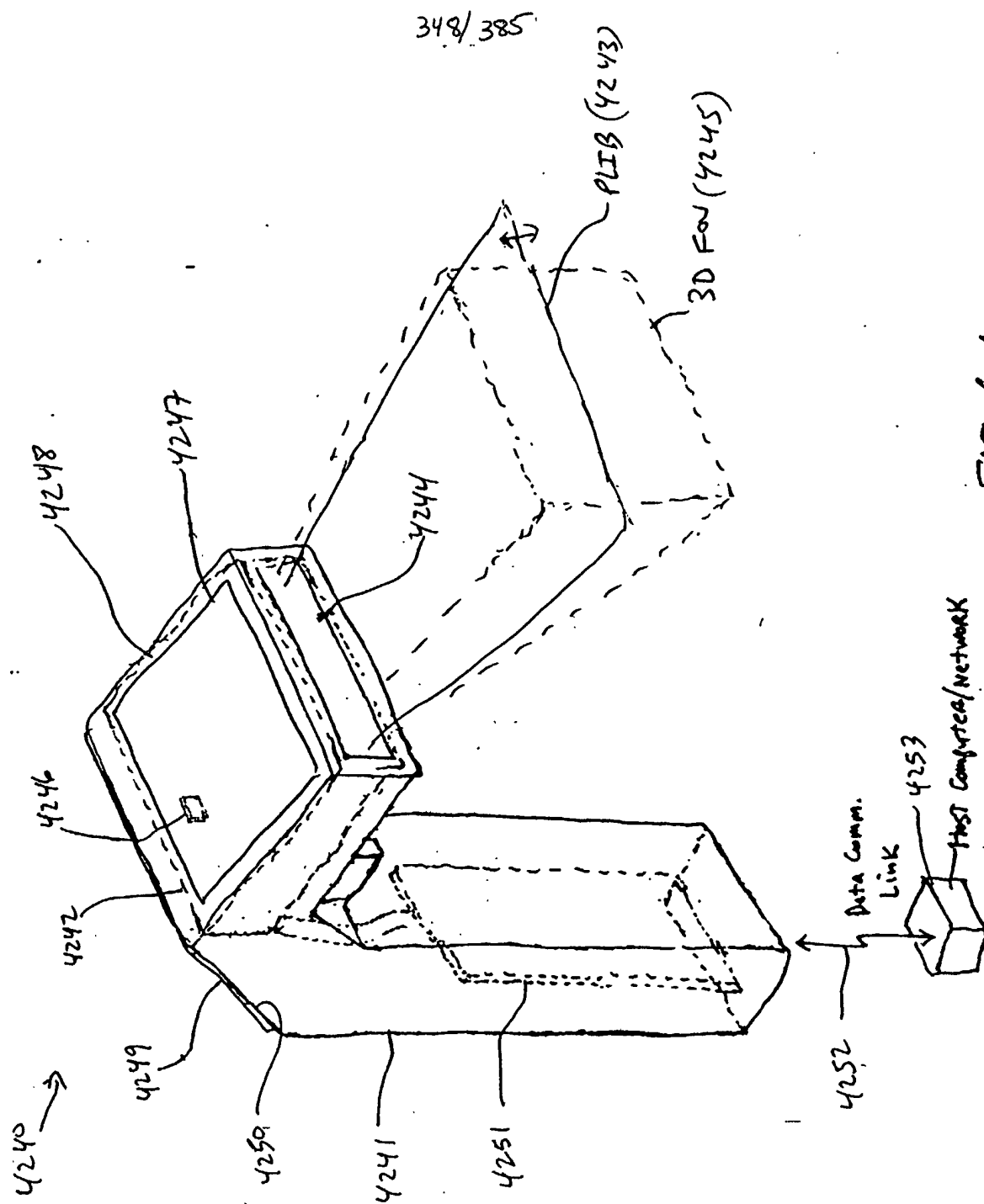


FIG. 60A

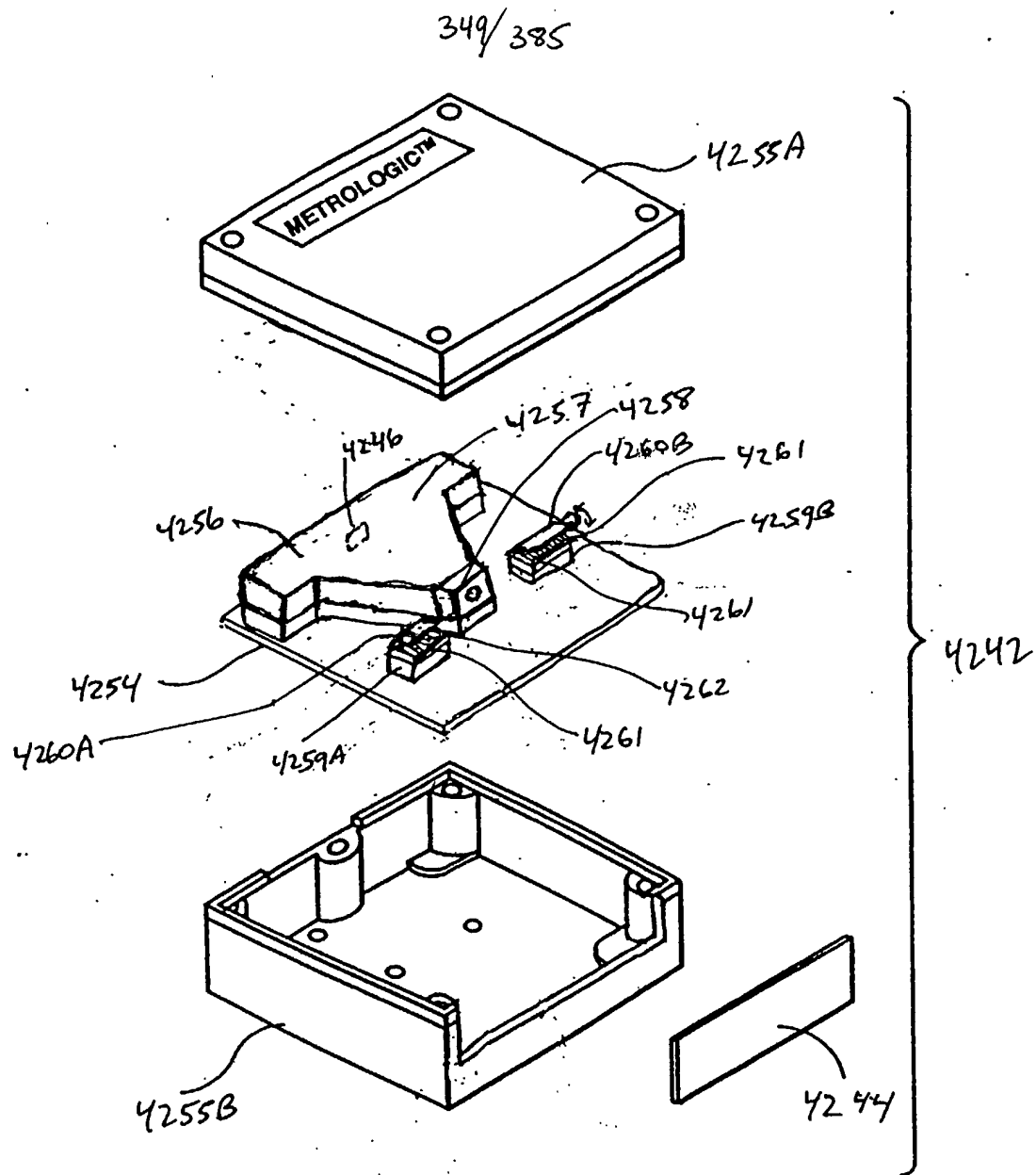


FIG. 60B

Bifalton (Tong. phase mod.)  
Fig. 1 I 17A-17B

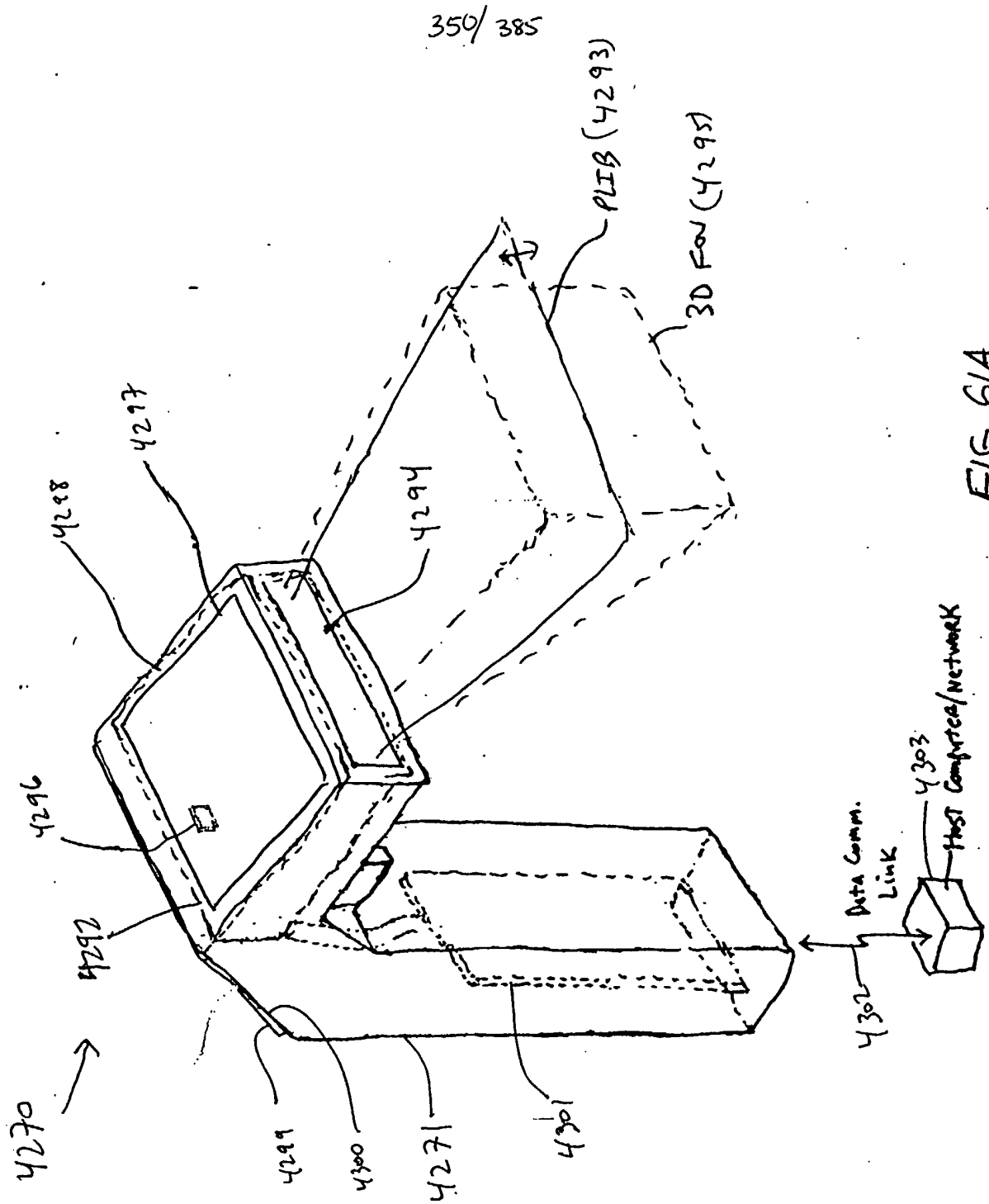


FIG. 61A

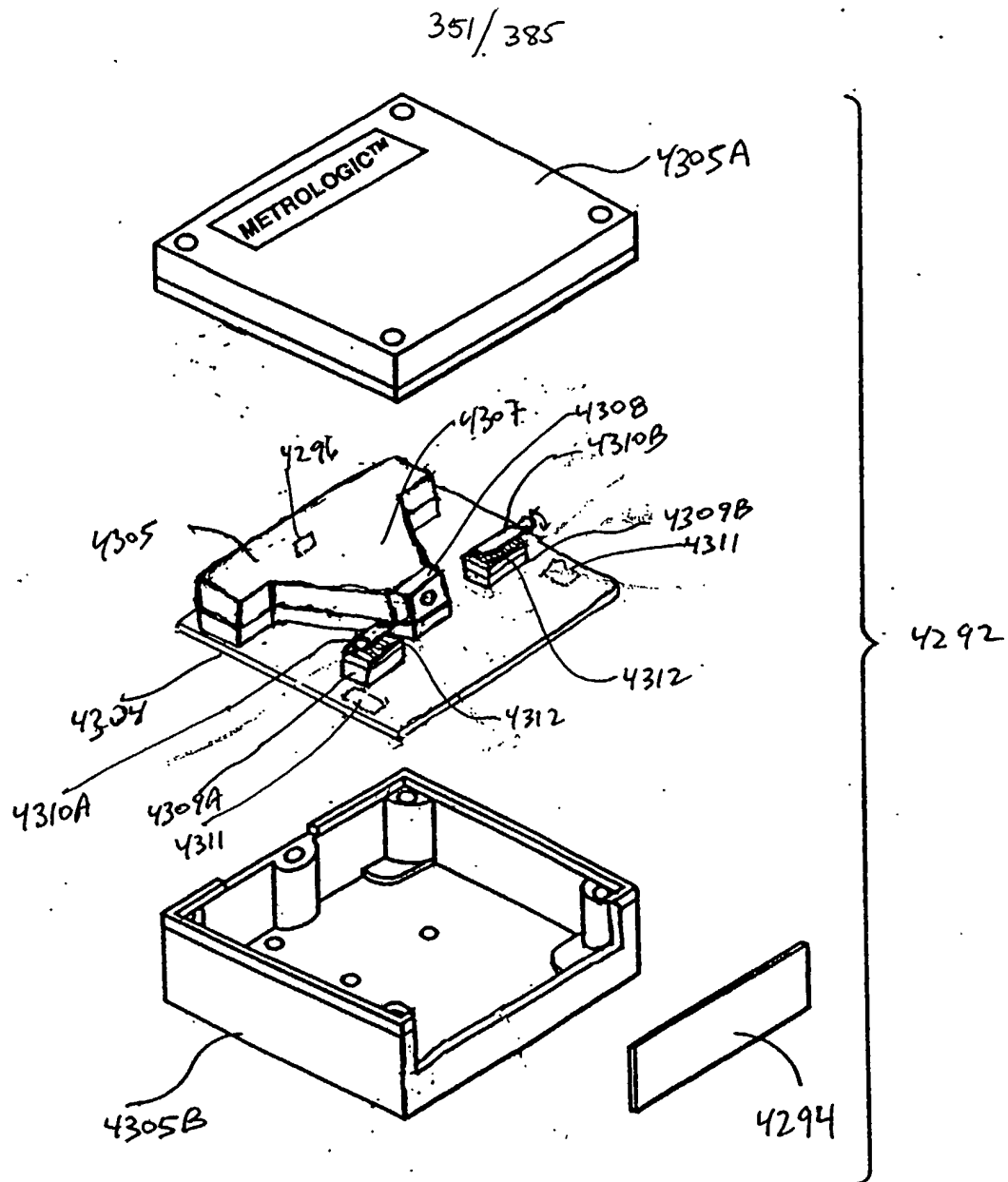


FIG. 61B

mod. hugging

Fig. 1A-19B

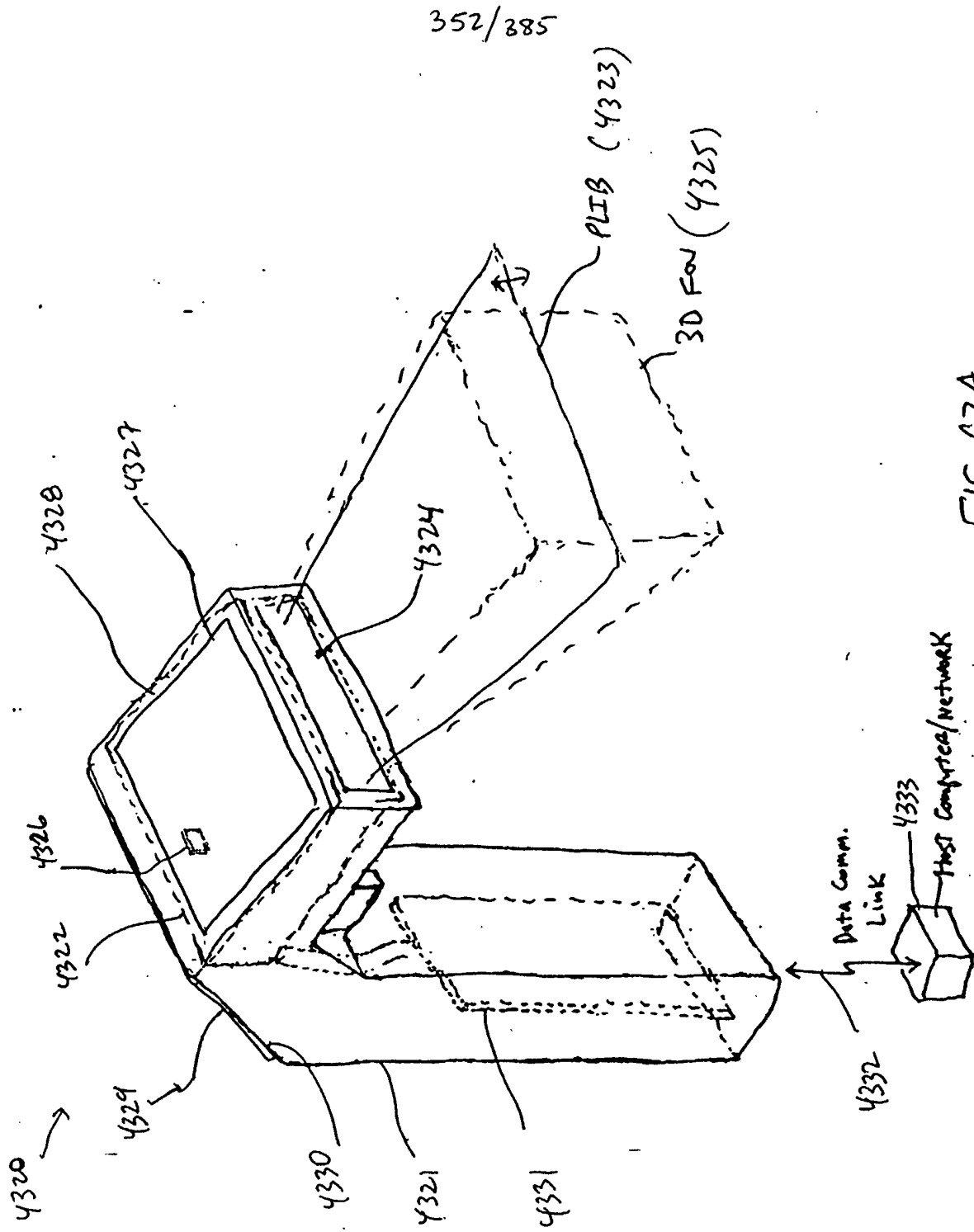


FIG. 62A

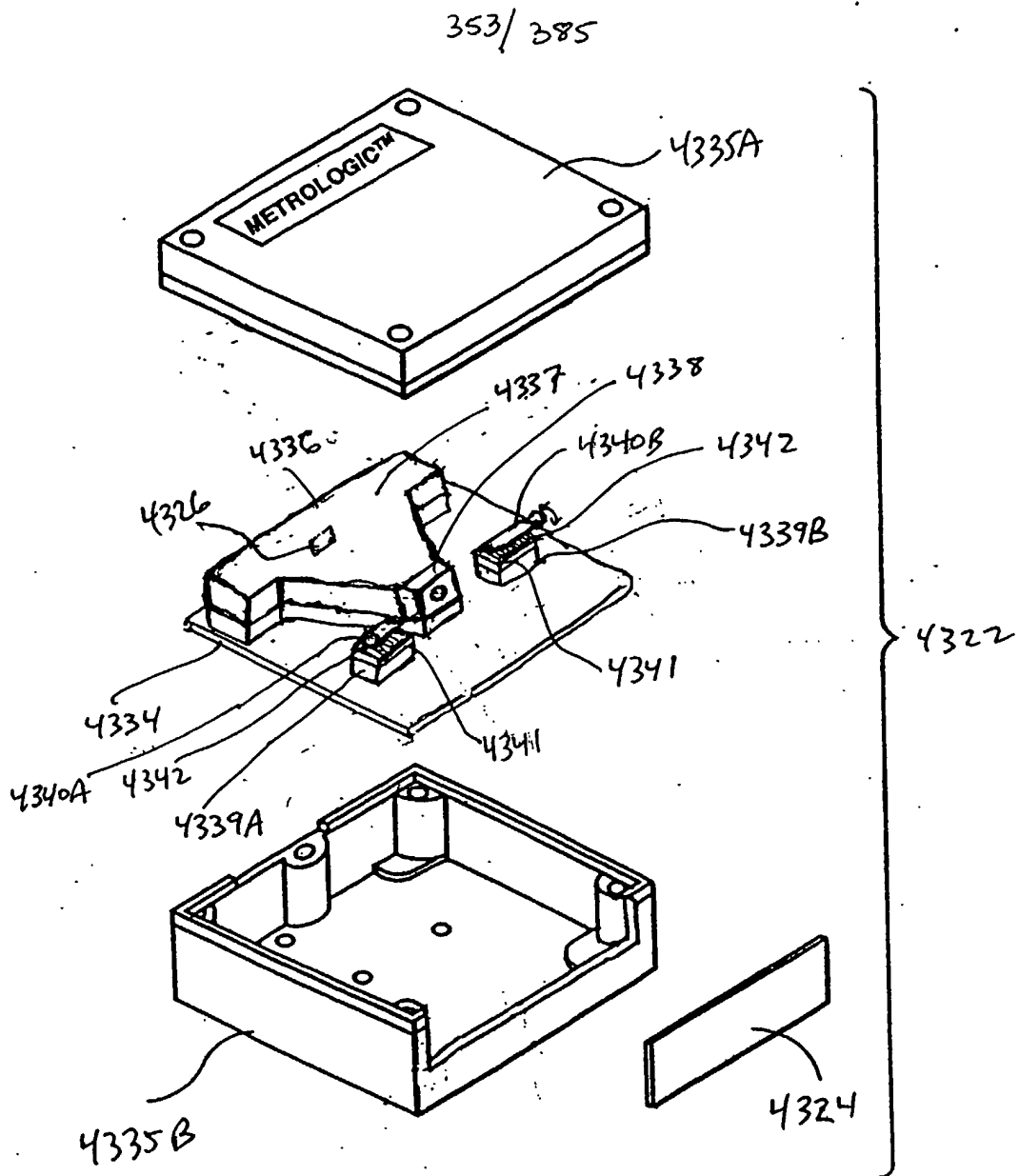


FIG. 62B

measuring  
spot intensity  
mod. panel

Fig. 1E21A-21D

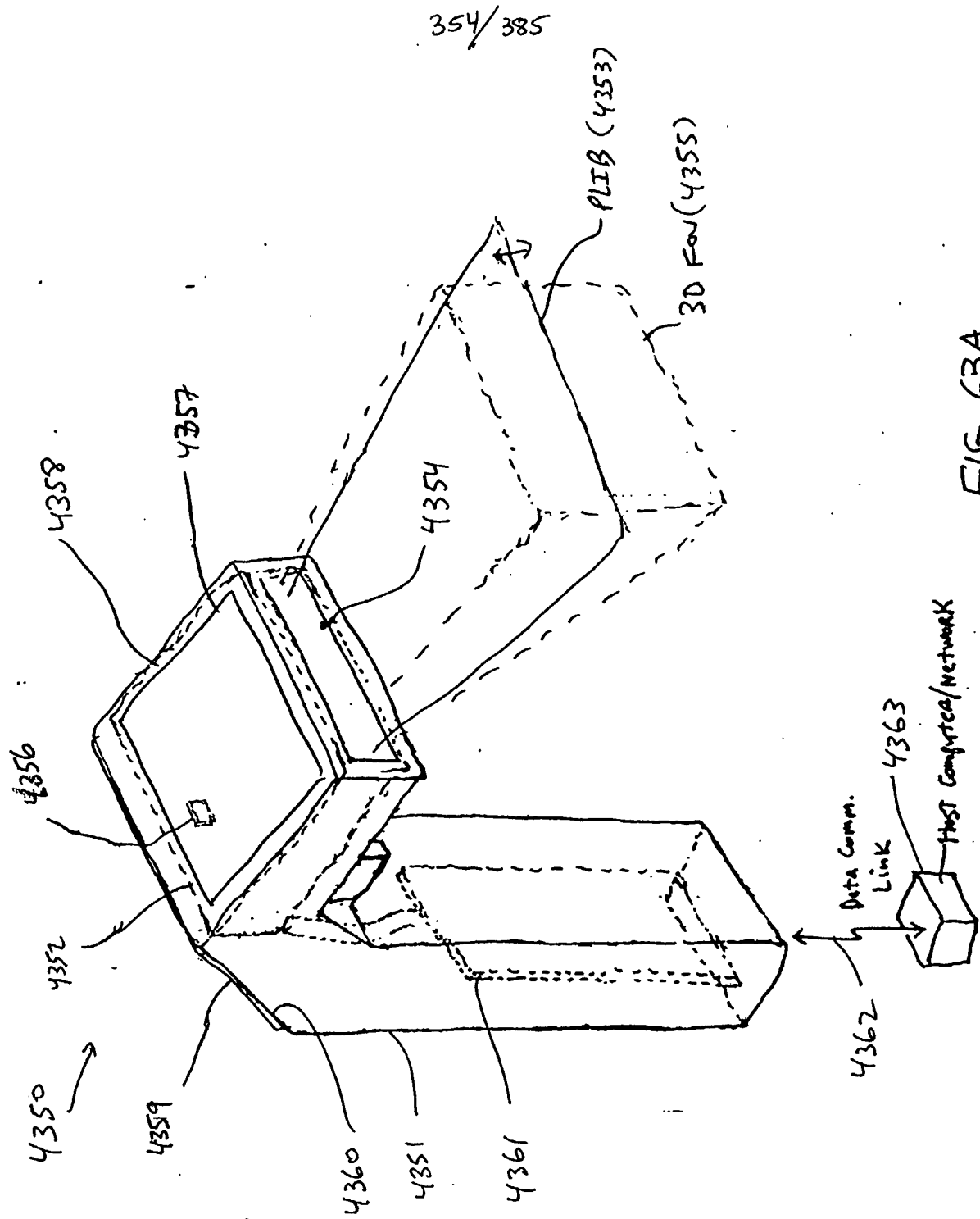


FIG. 63A

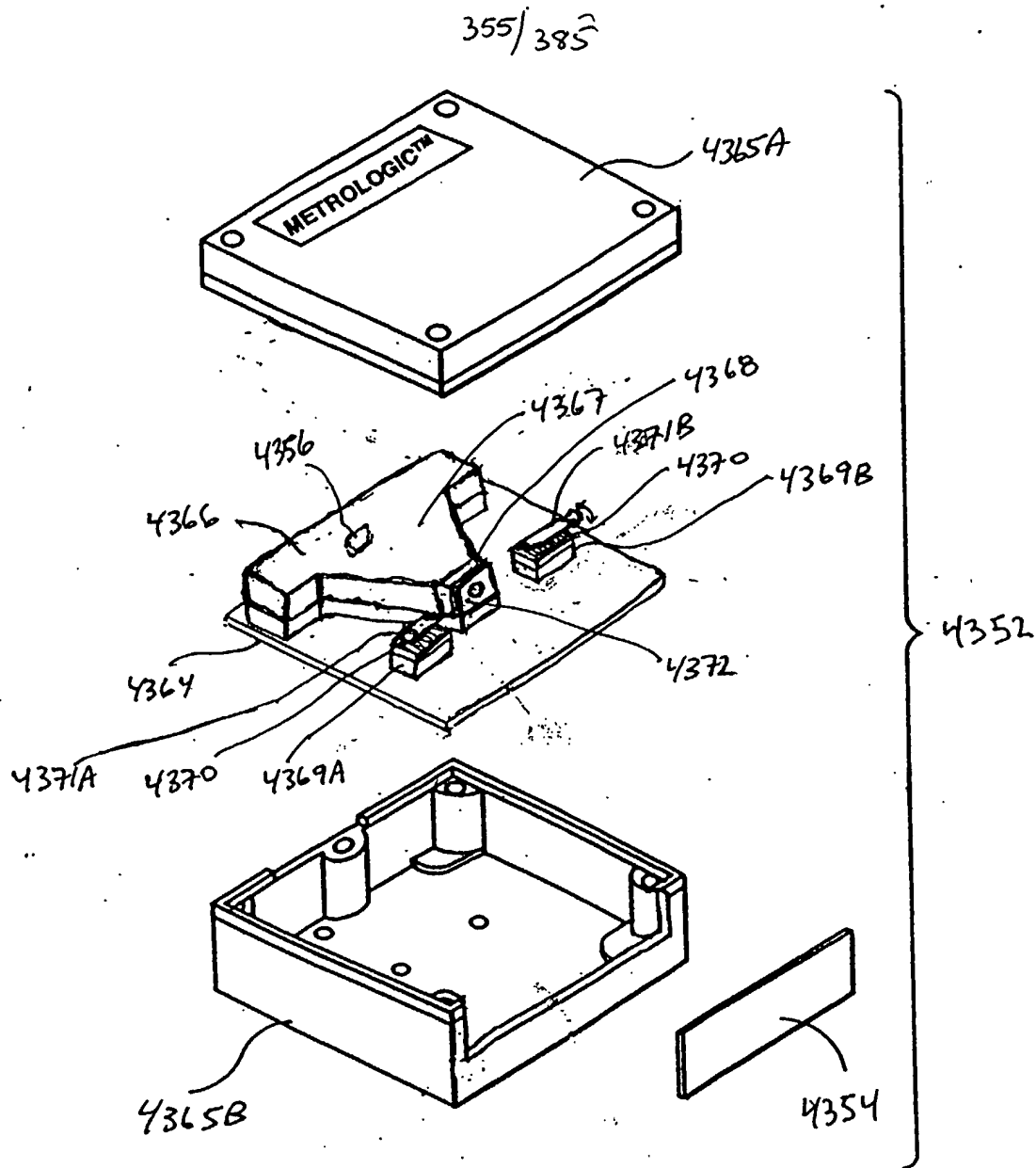


FIG. 63B

ED of.  
Mechanical Refitting IPIs  
Fig 1<sup>st</sup> 23A-23B



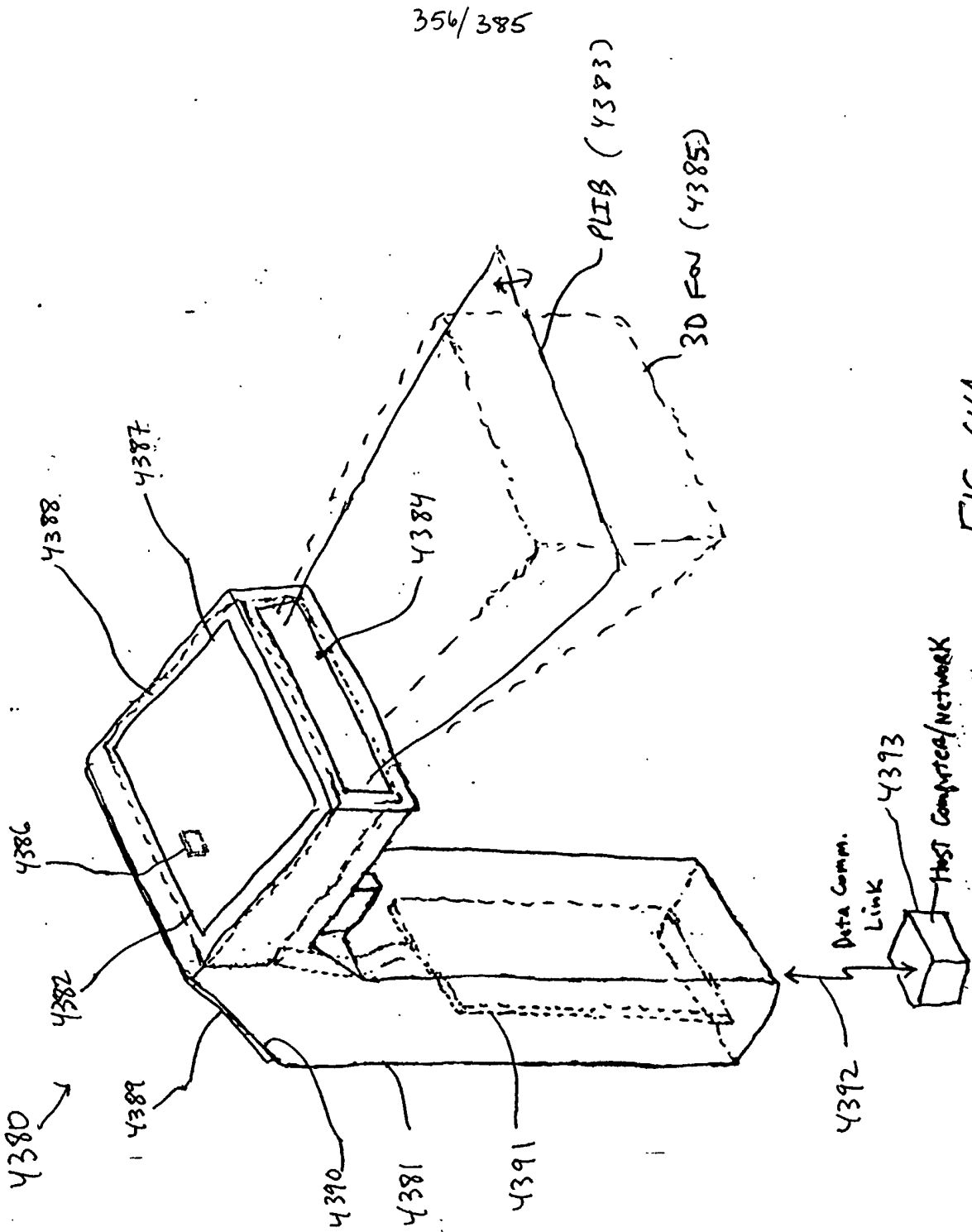


FIG. 64A

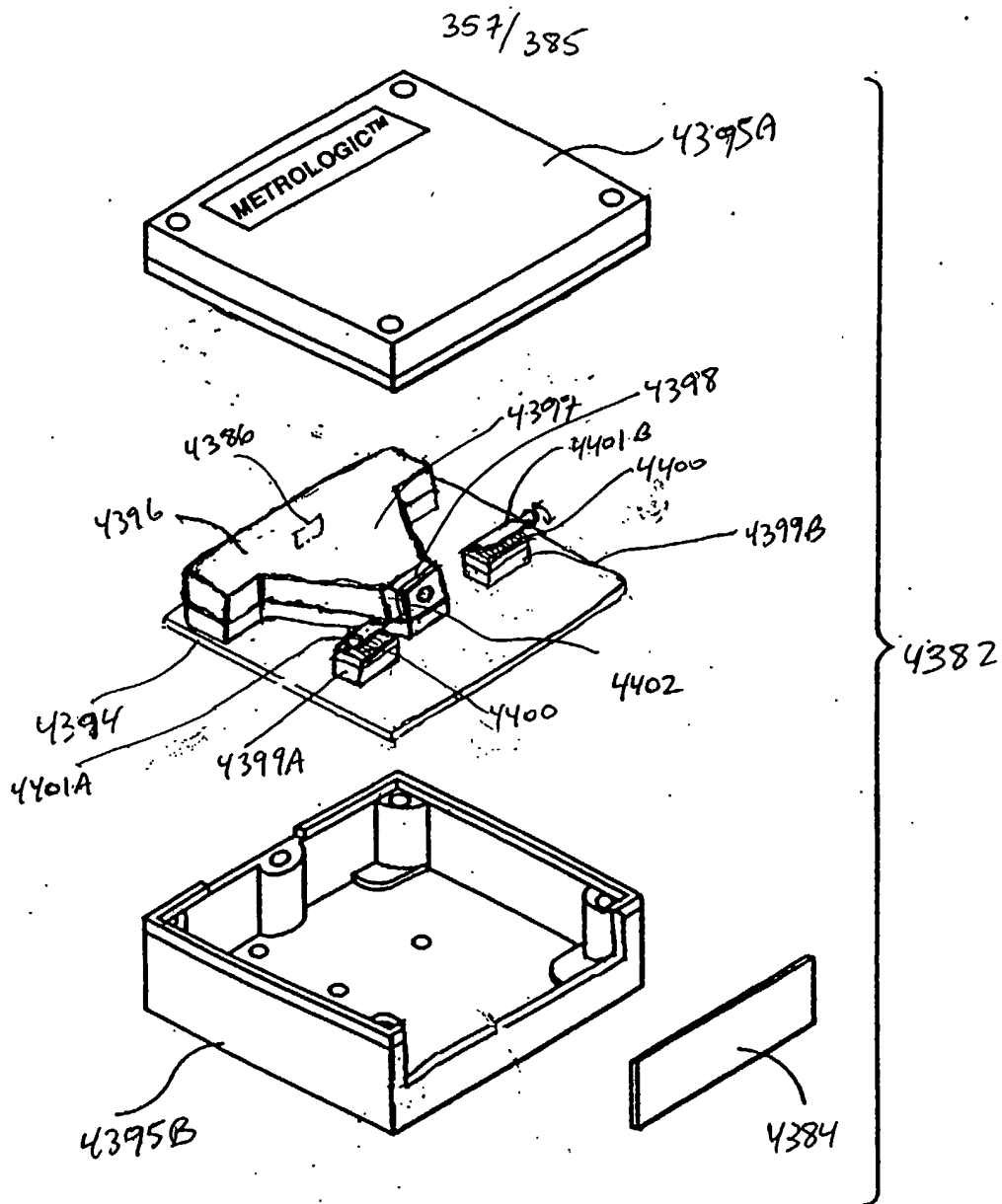


FIG. 64B

\* E-optical  
Shutter Buffer  
IP Lens  
Fig. 1E24A

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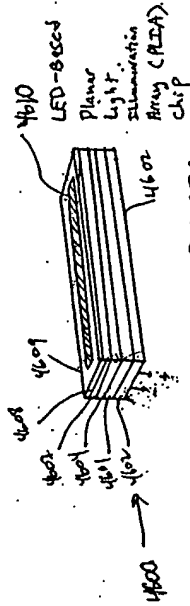


FIG. 67A

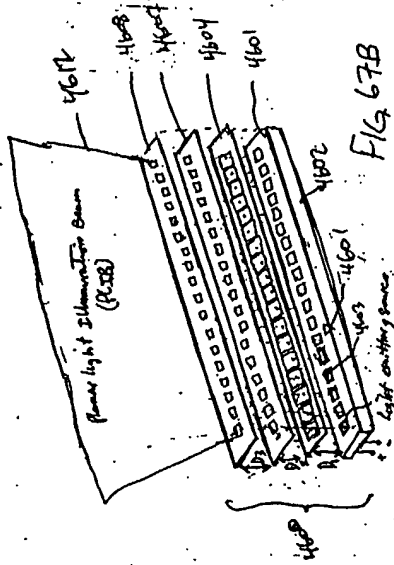


FIG. 67B

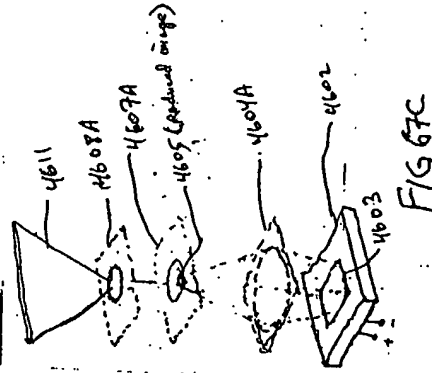


FIG. 67C

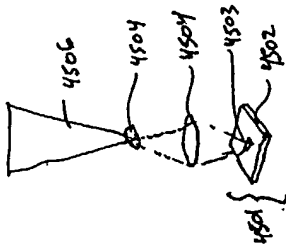


FIG. 65B

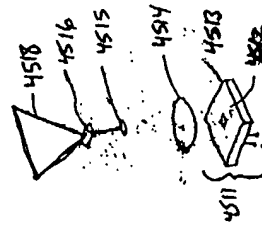


FIG. 66B

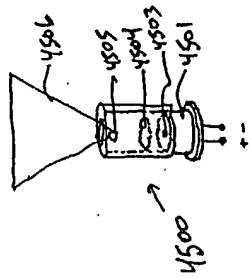


FIG. 65A

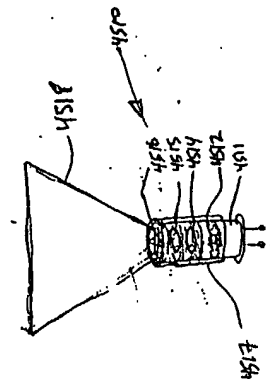
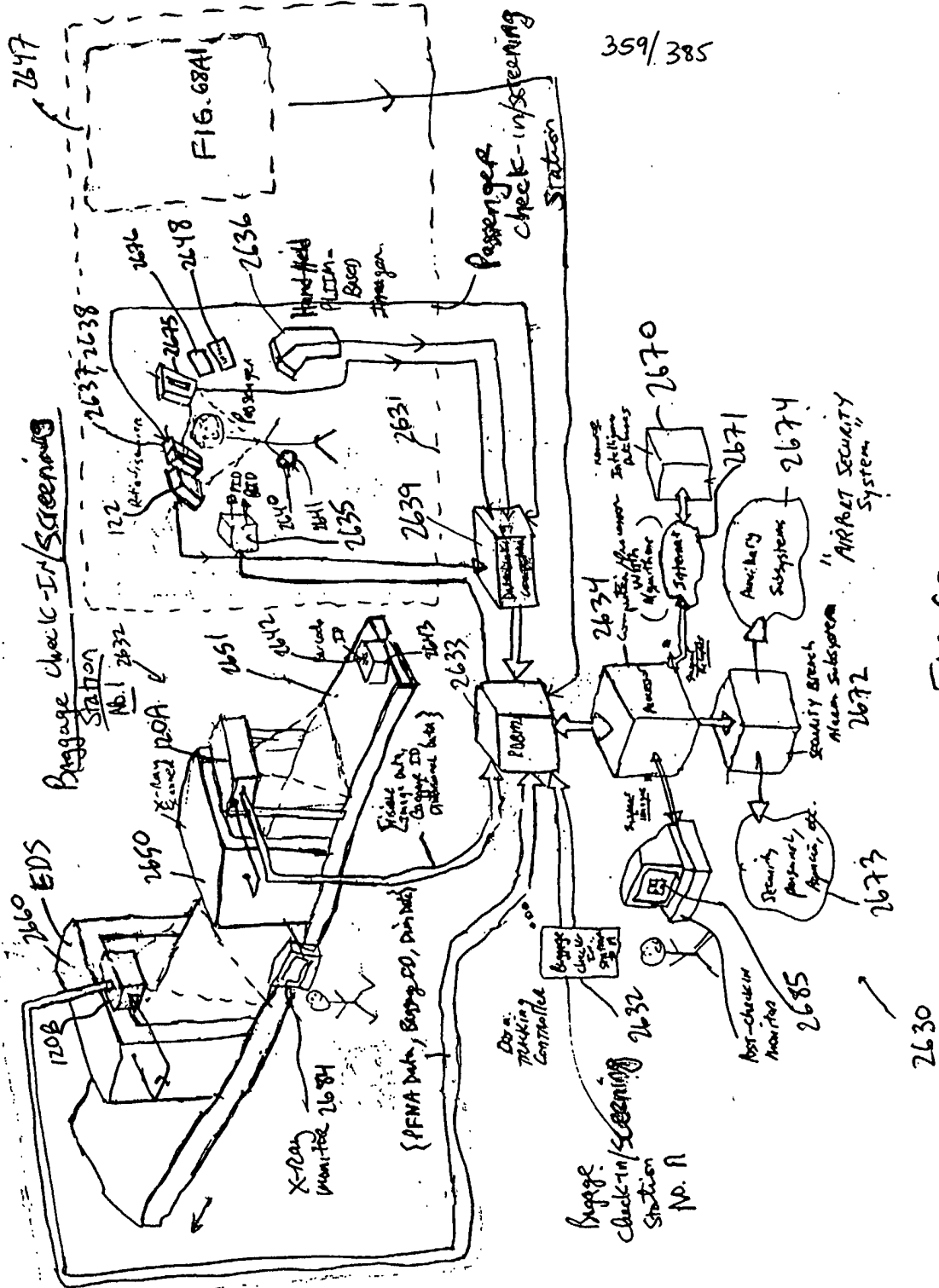


FIG. 66A



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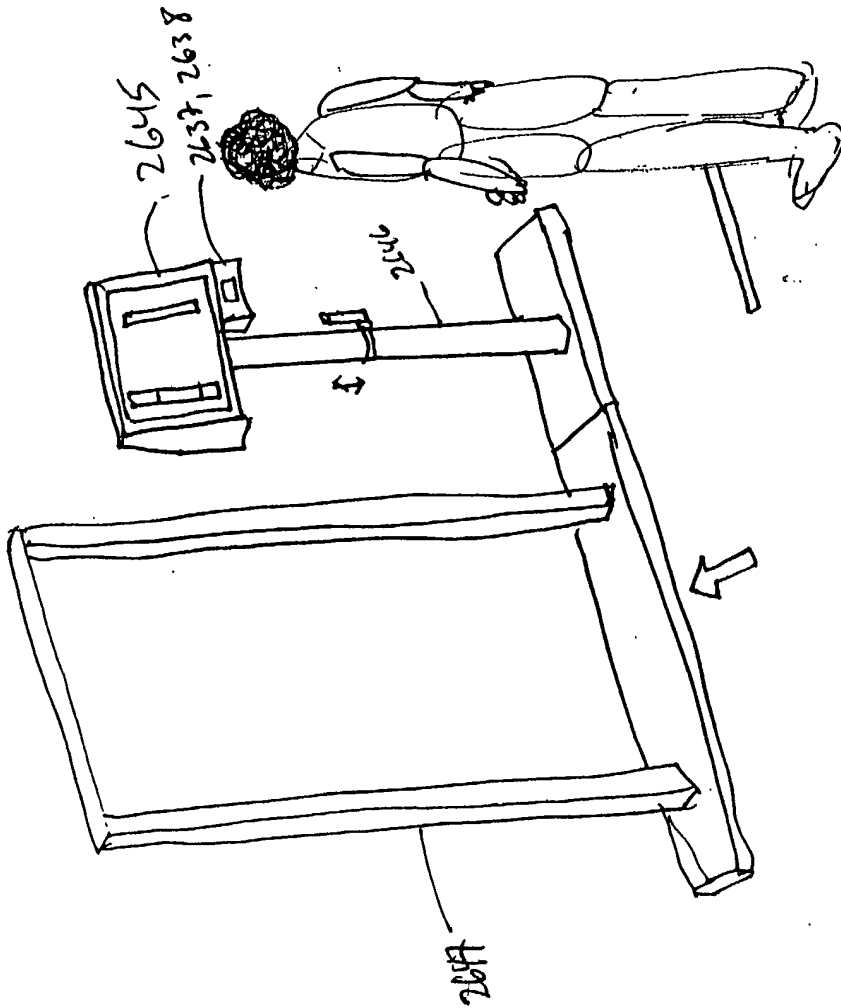


FIG. 68A

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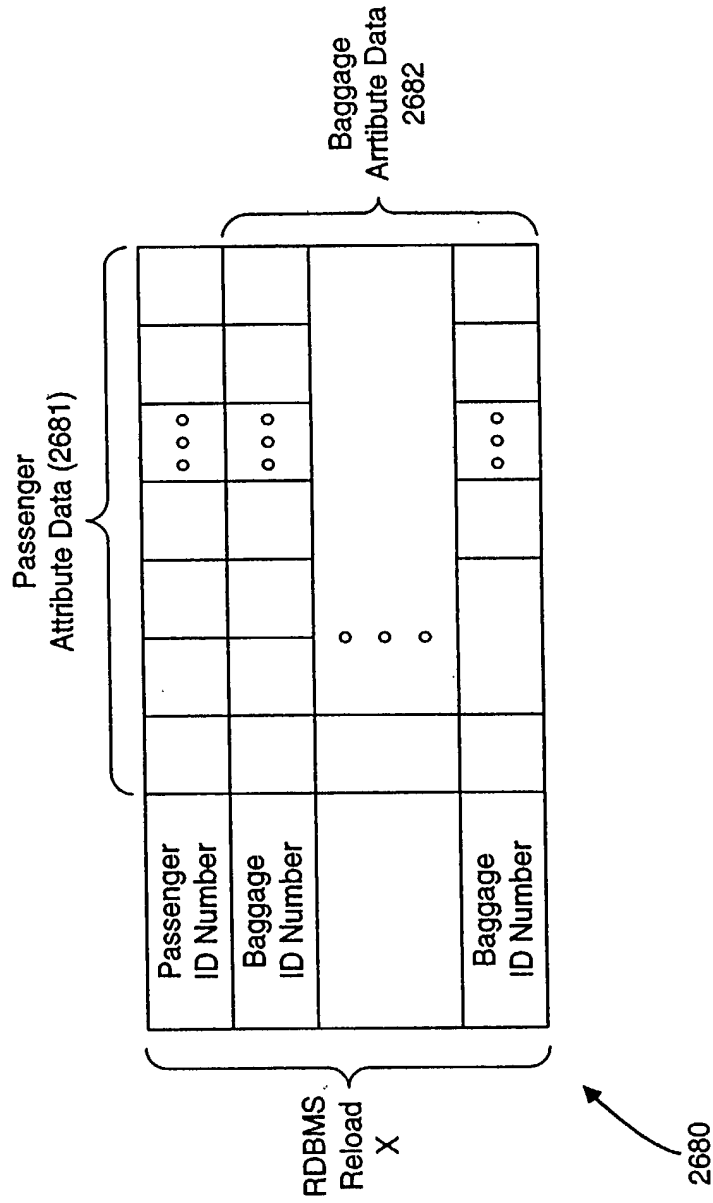


FIG. 68B

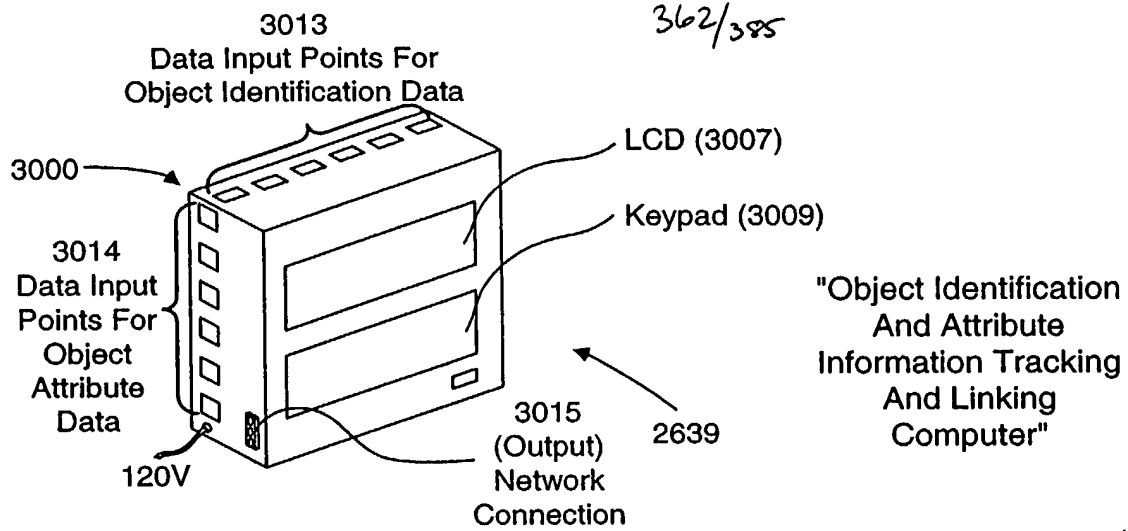


FIG. 68C1

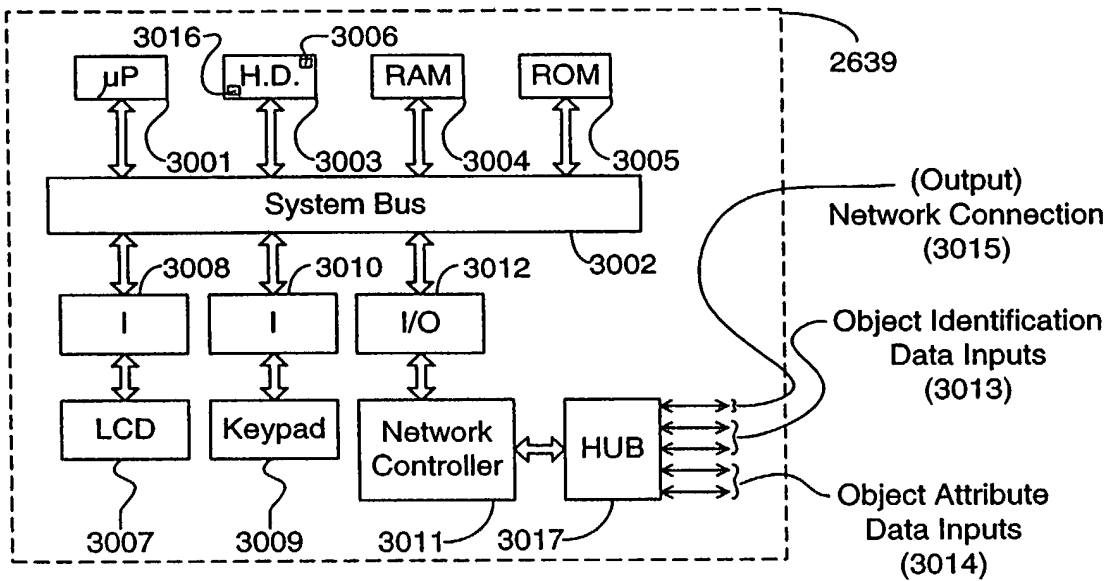


FIG. 68C2

Object Identification And Attribute Information Tracking And Linking Computer System.

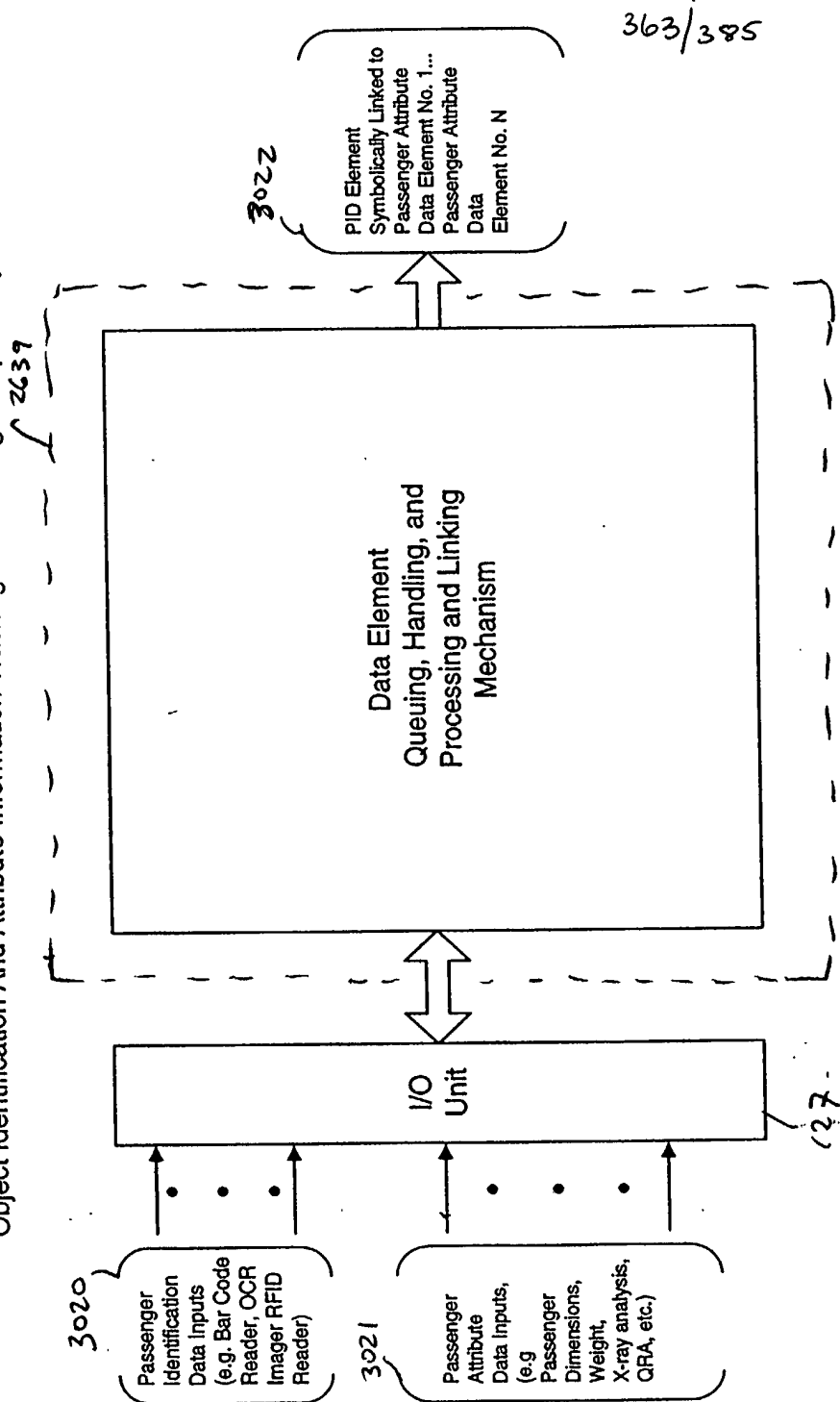


FIG. 68C3



# Data Element Queuing, Handling, and Processing Subsystem Employed In The Object Identification And Attribute Acquisition System Of The Present Invention. (131)

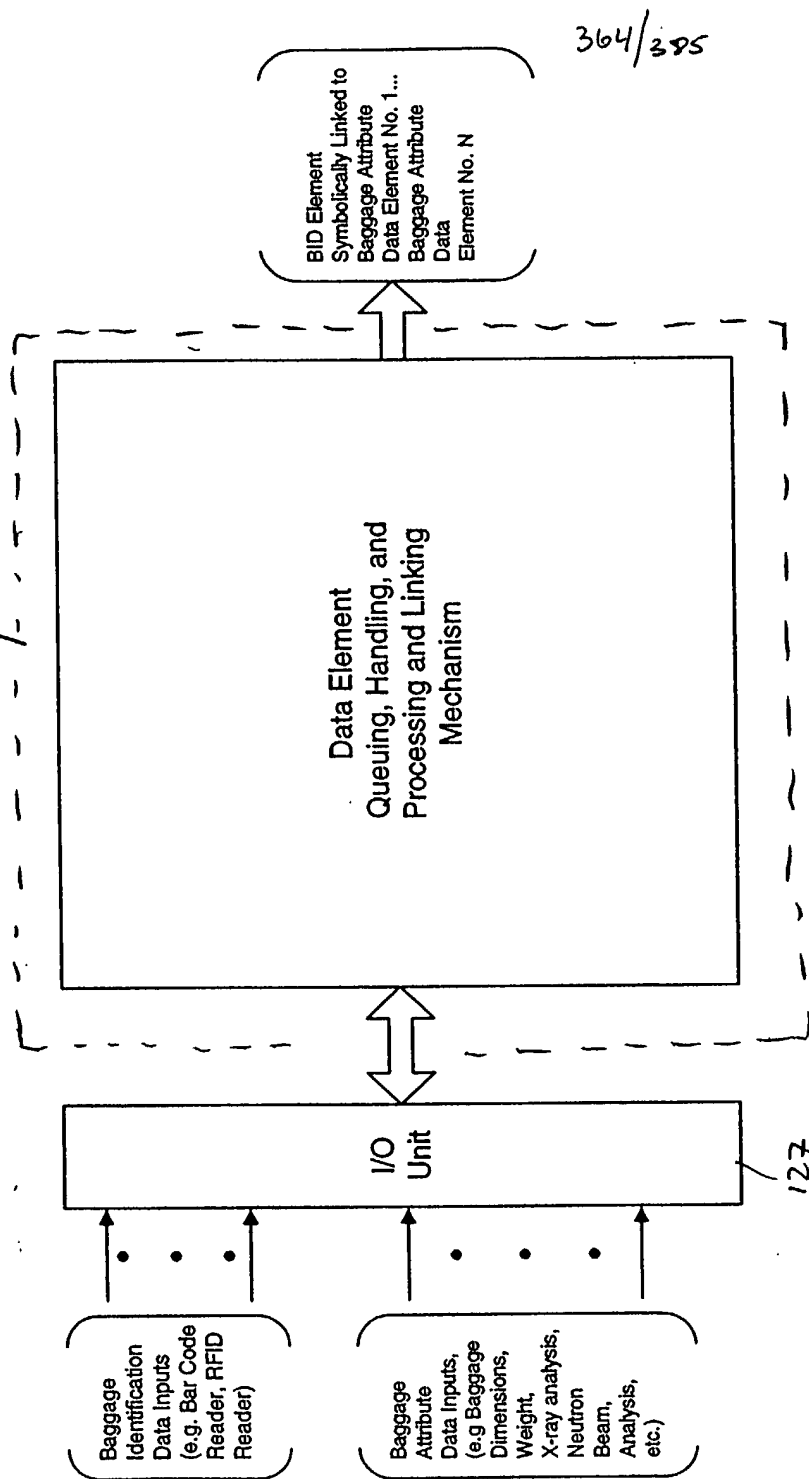


FIG. 68C4

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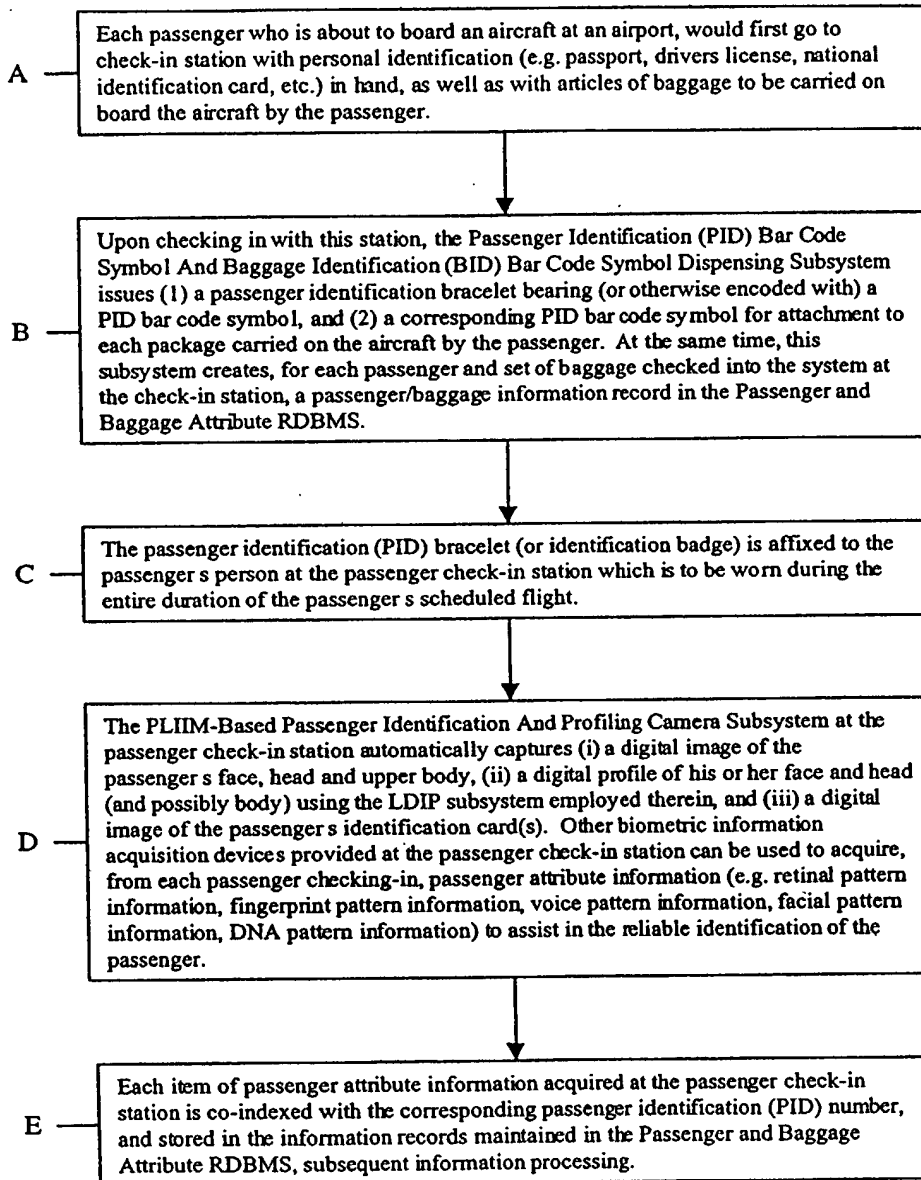


FIG. 68D1

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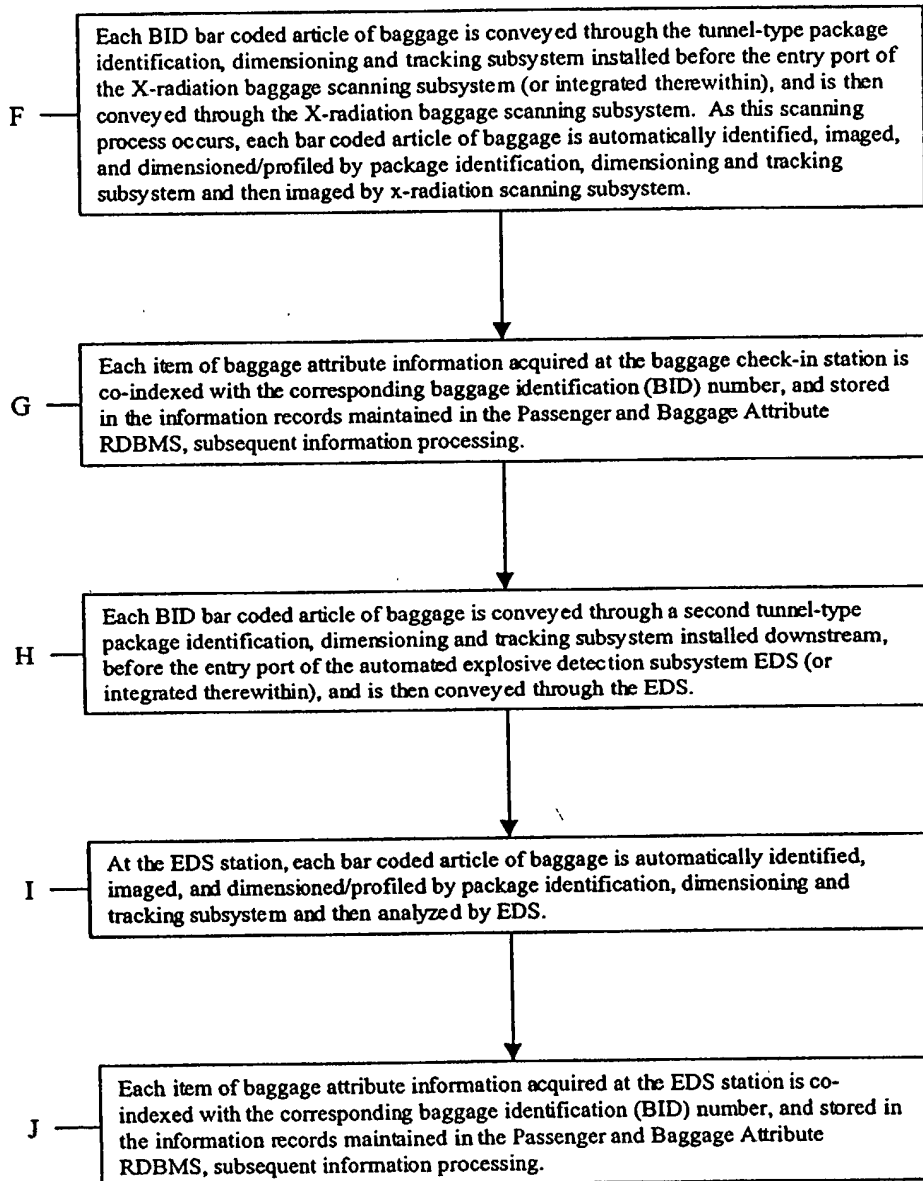


FIG. 68D2

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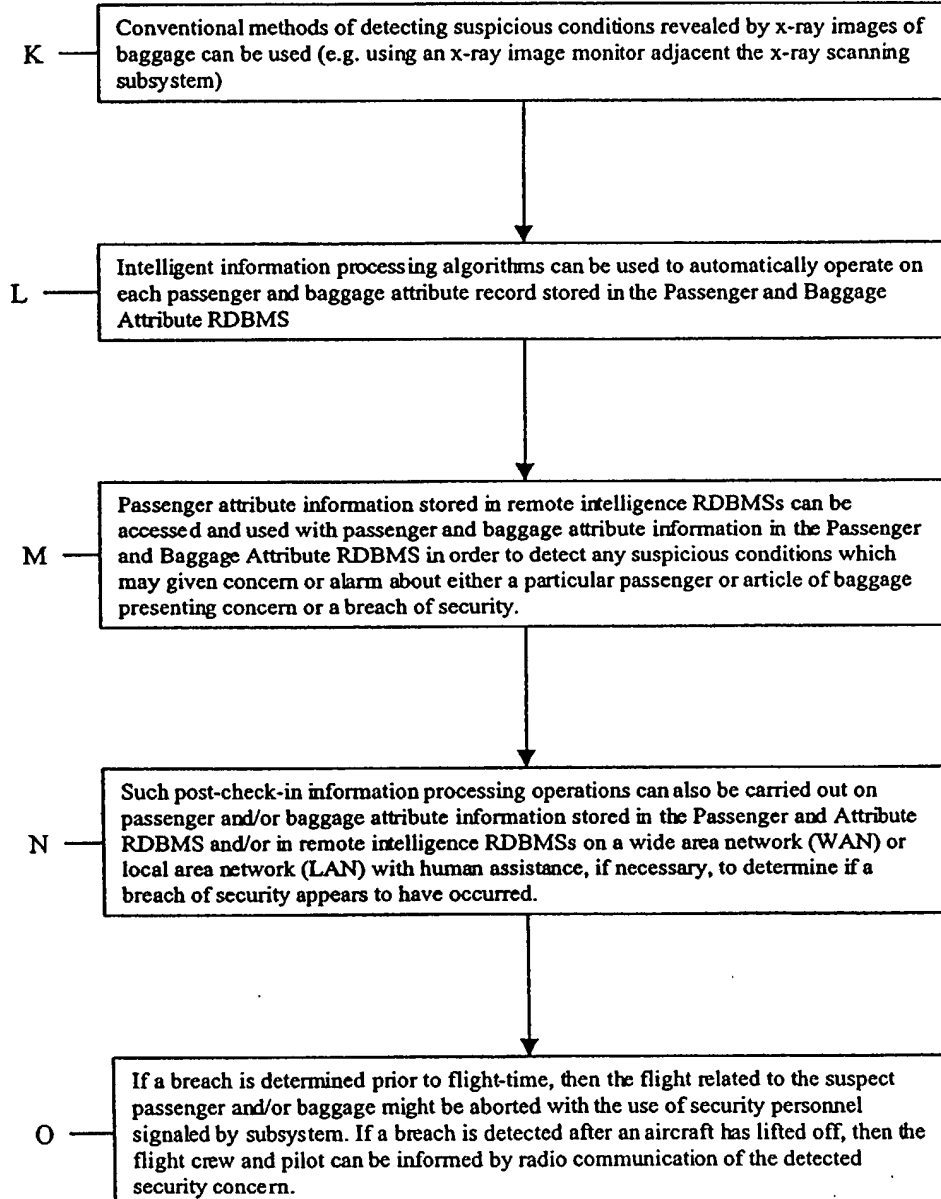


FIG. 68D3

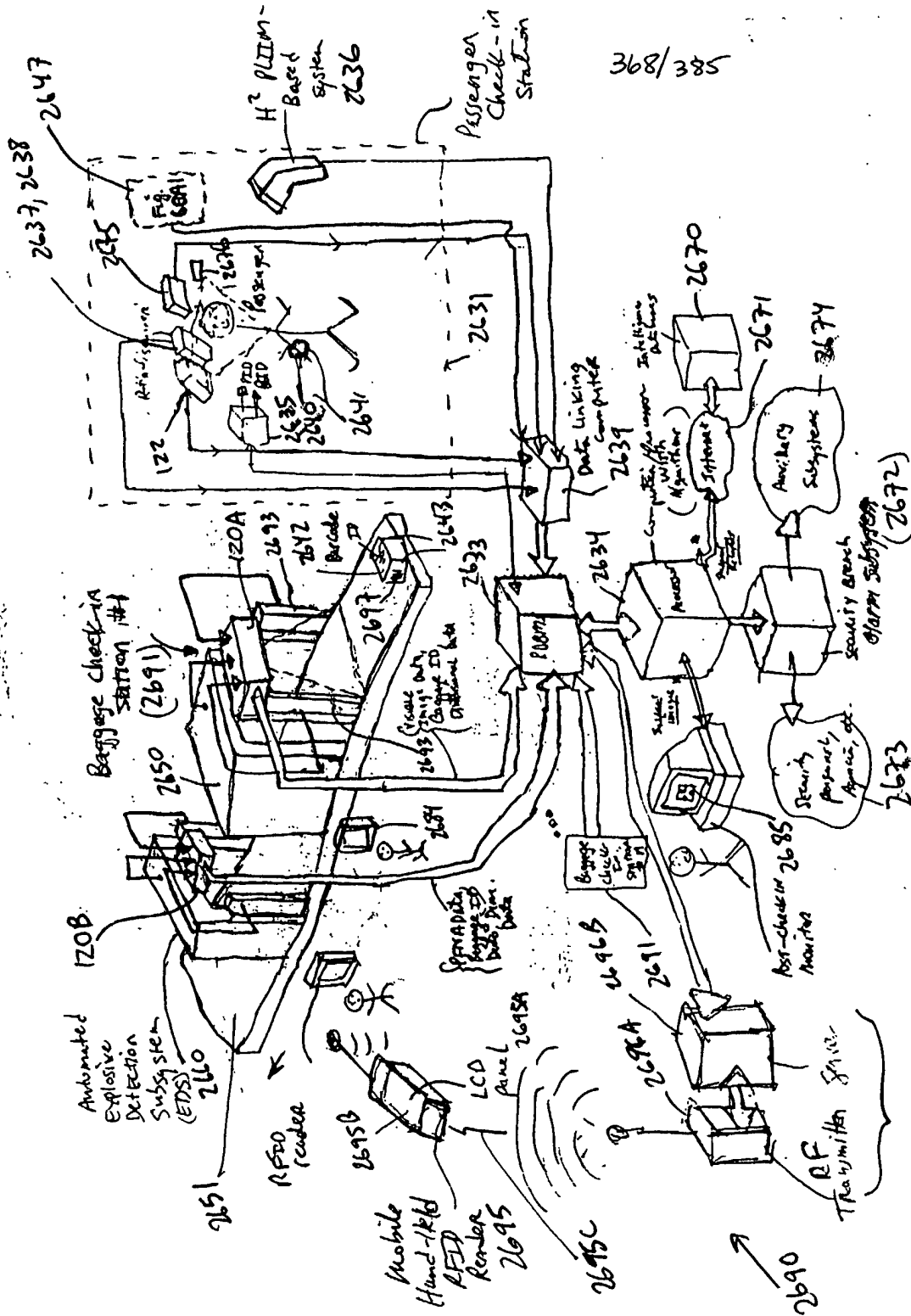


FIG. 69A

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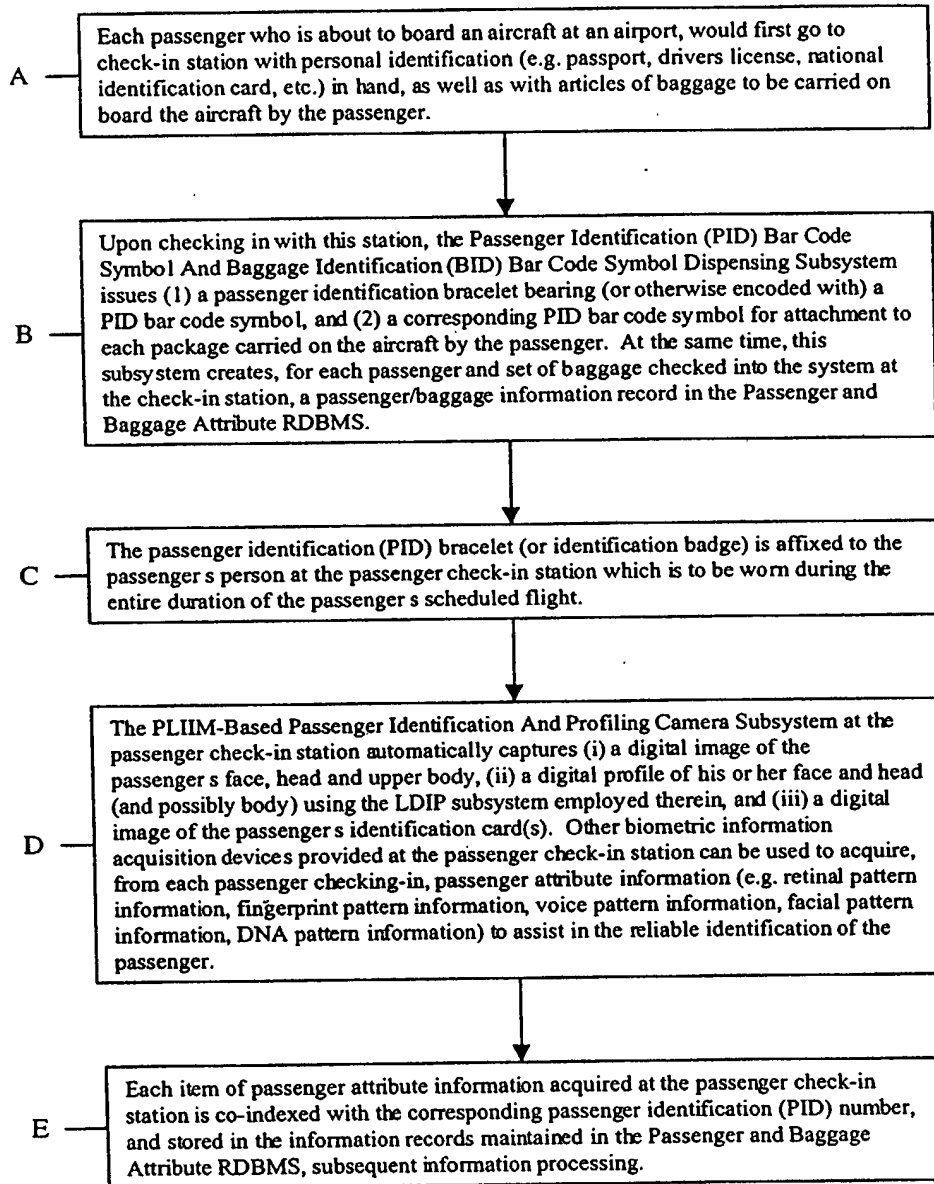


FIG. 69B1

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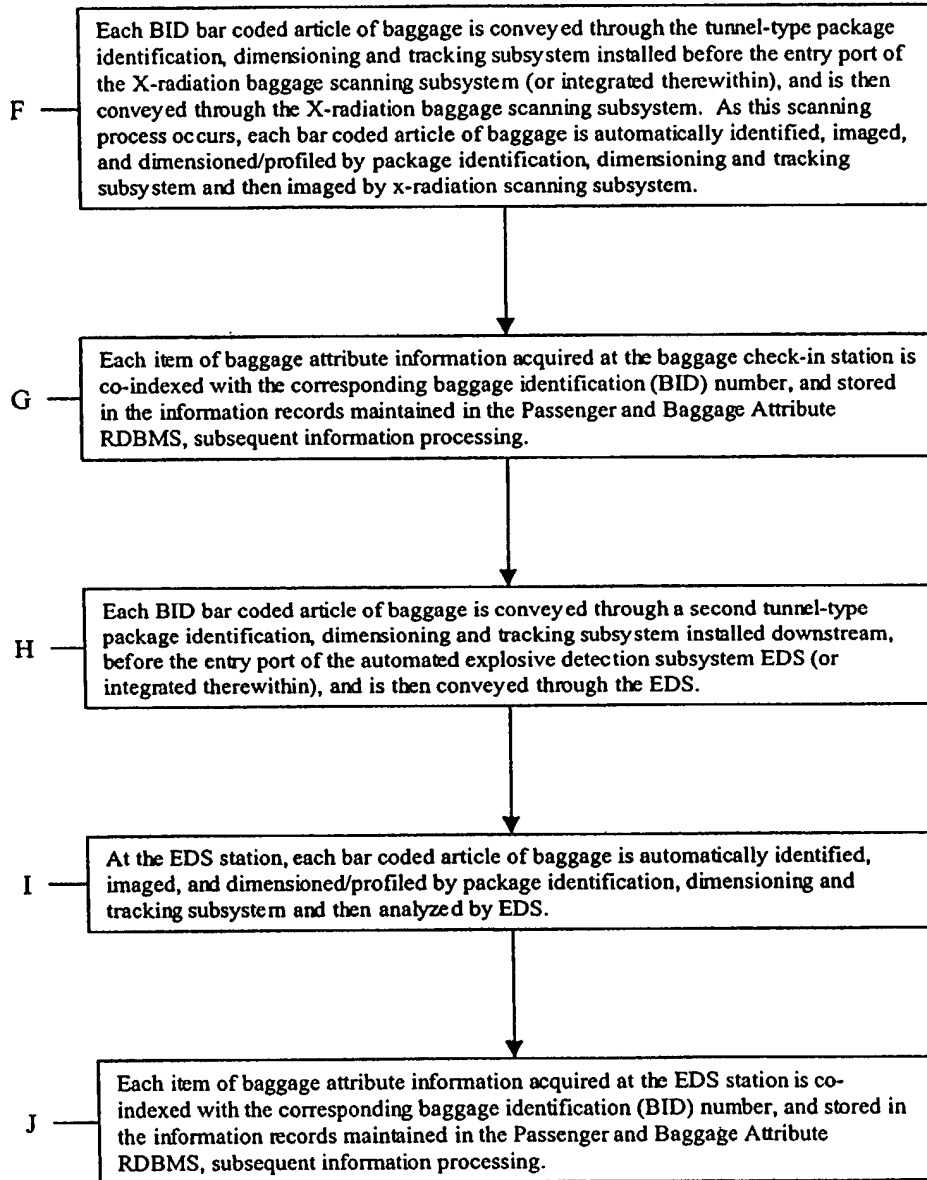


FIG 69B2

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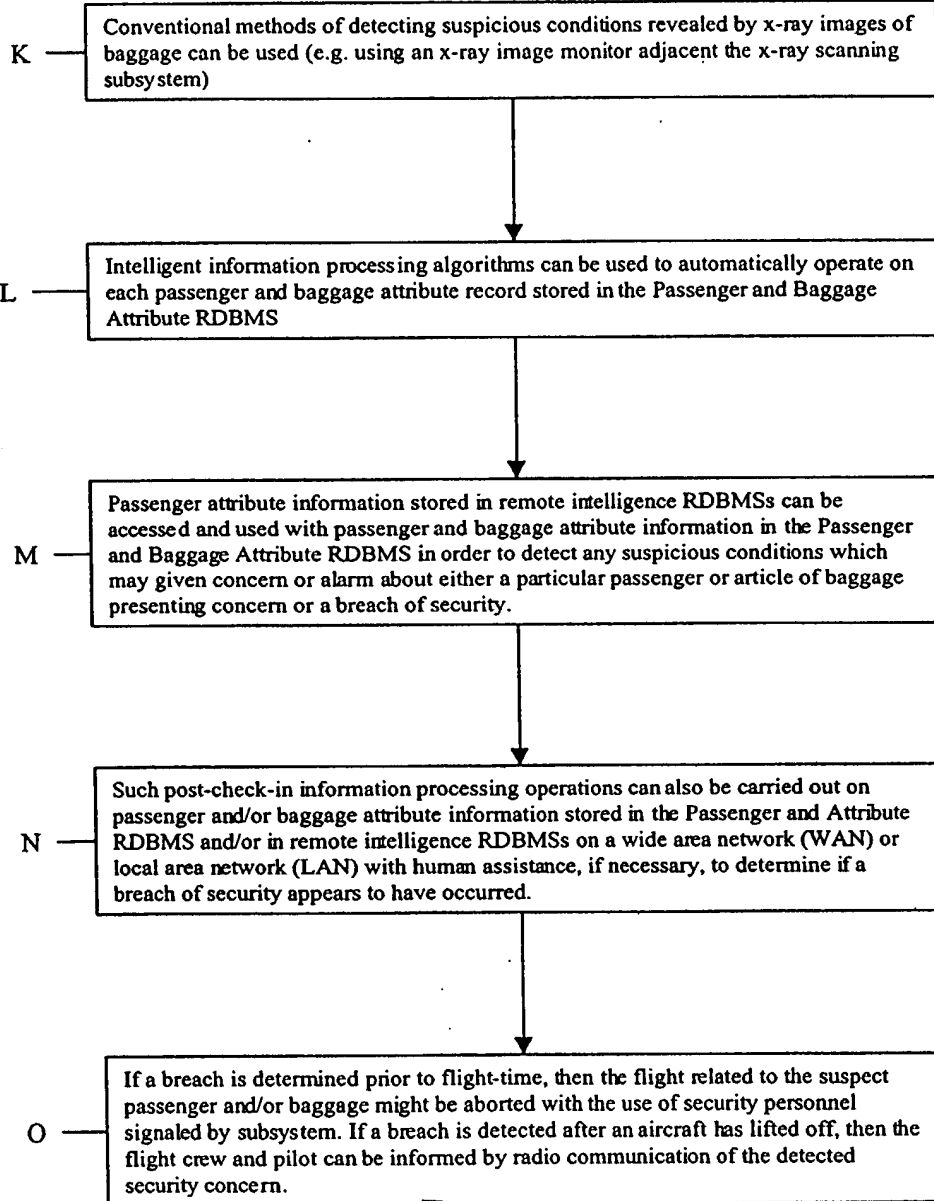


FIG. 69B3



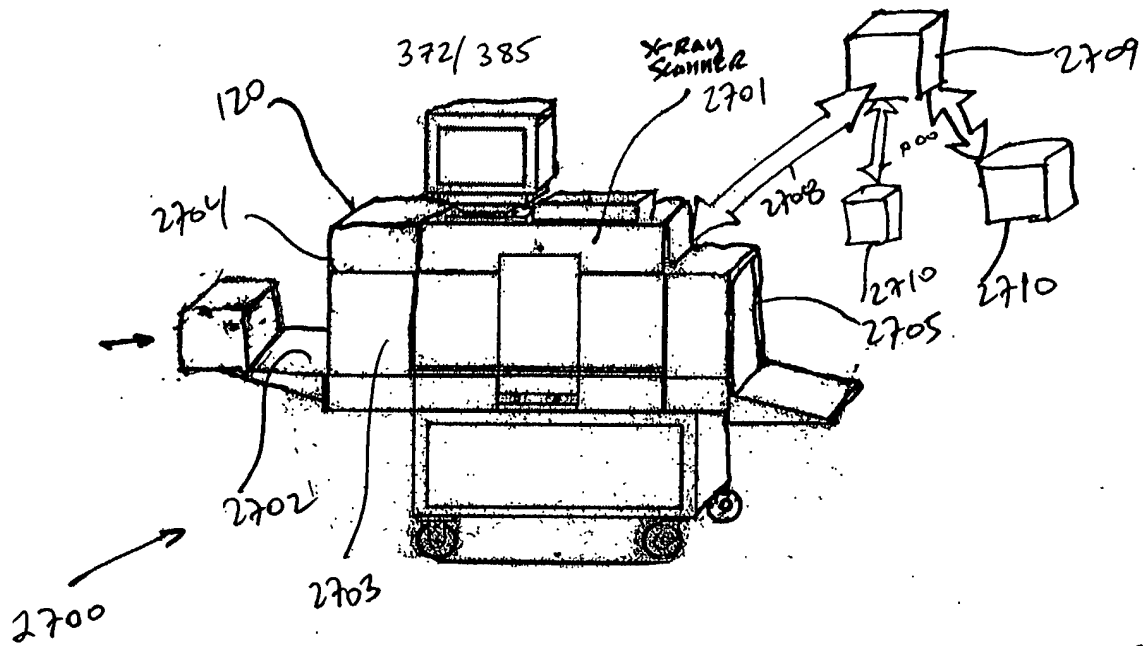
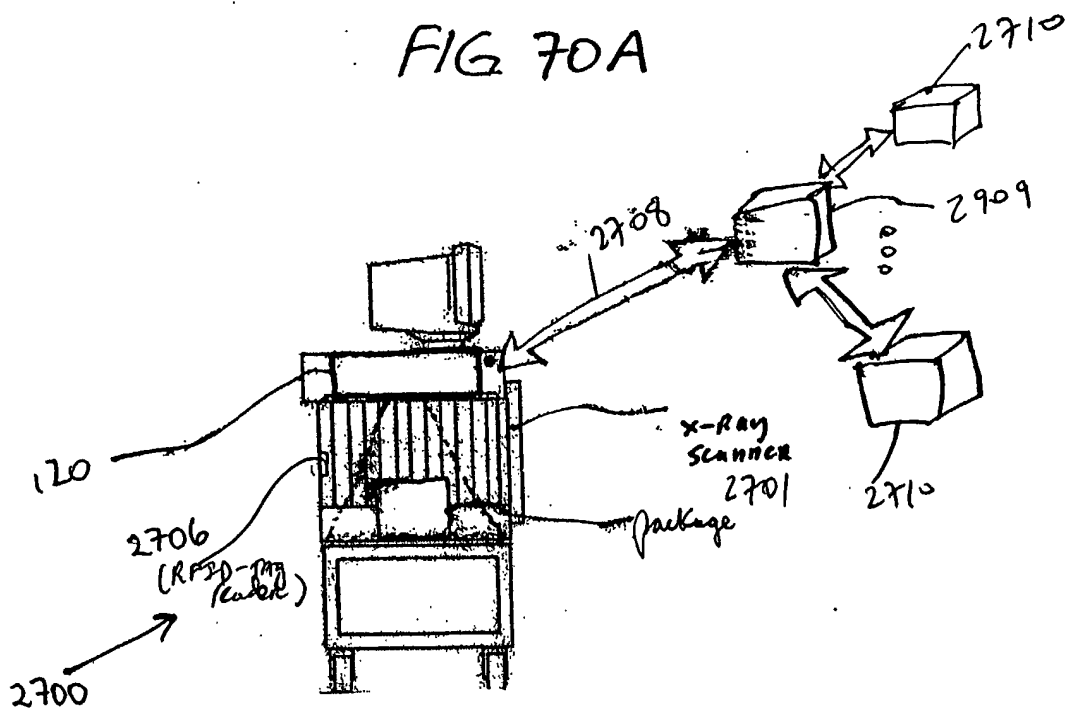
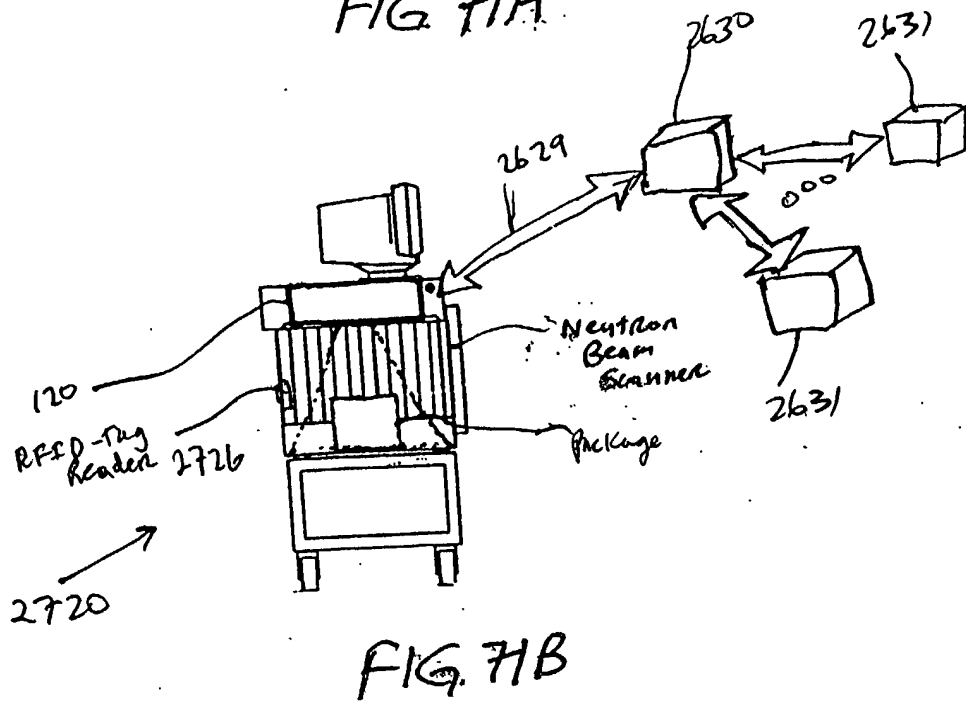
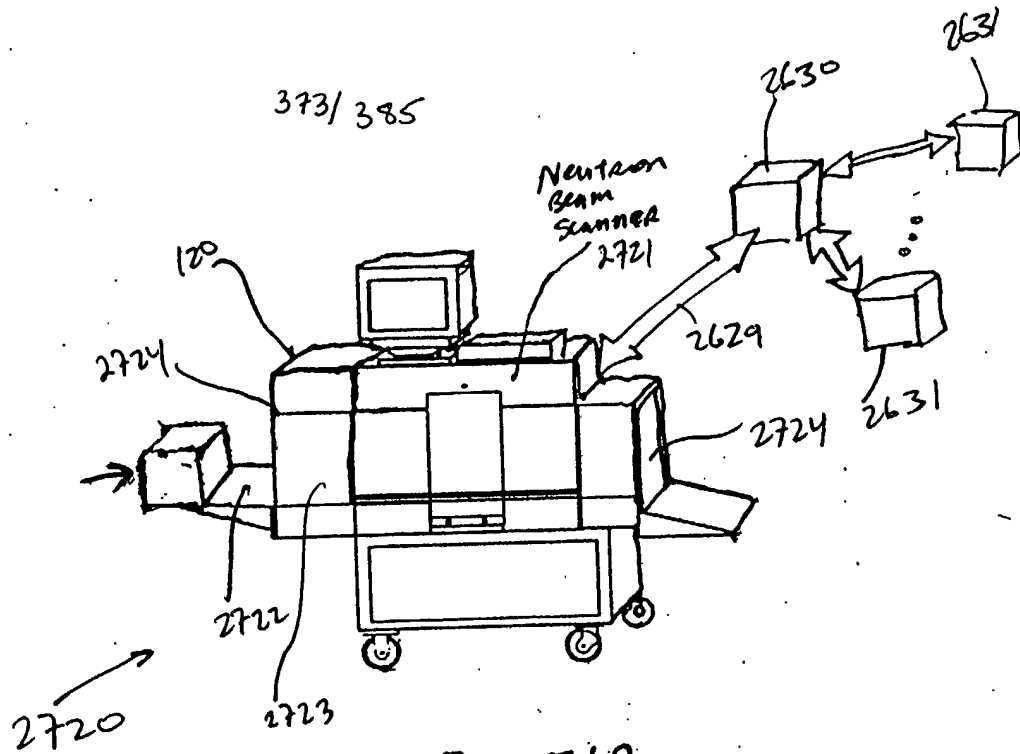


FIG 70A



F/G. 70B



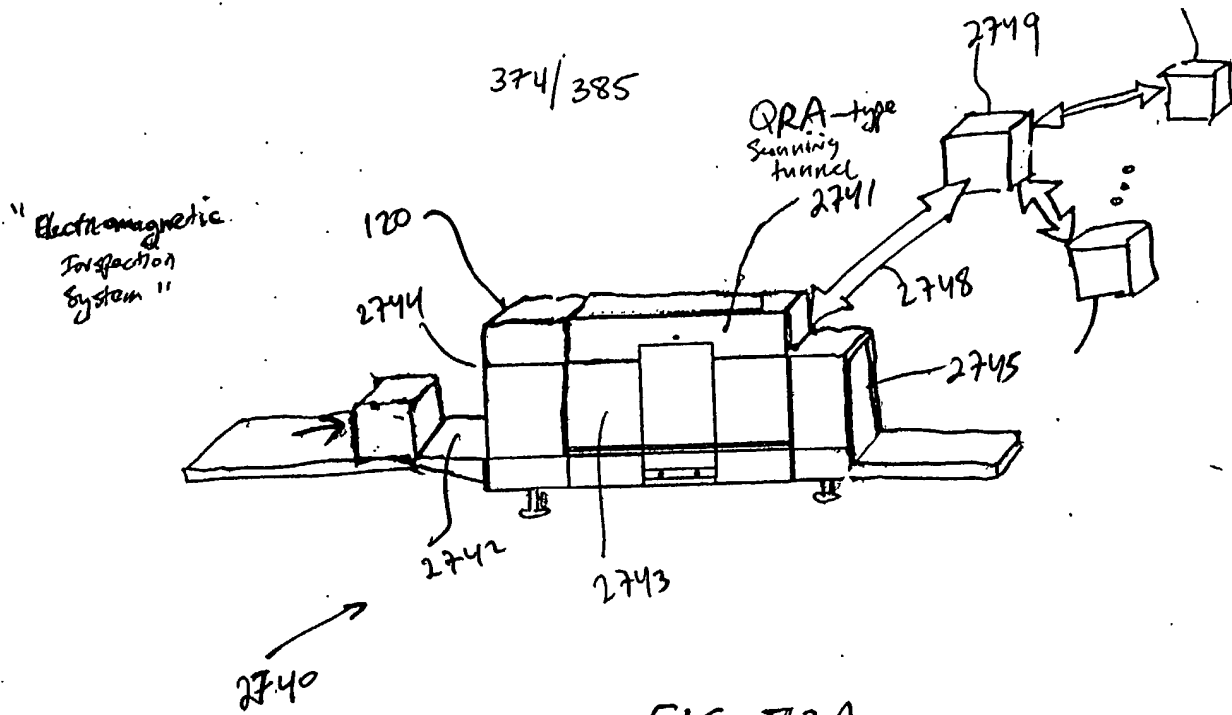


FIG 72A

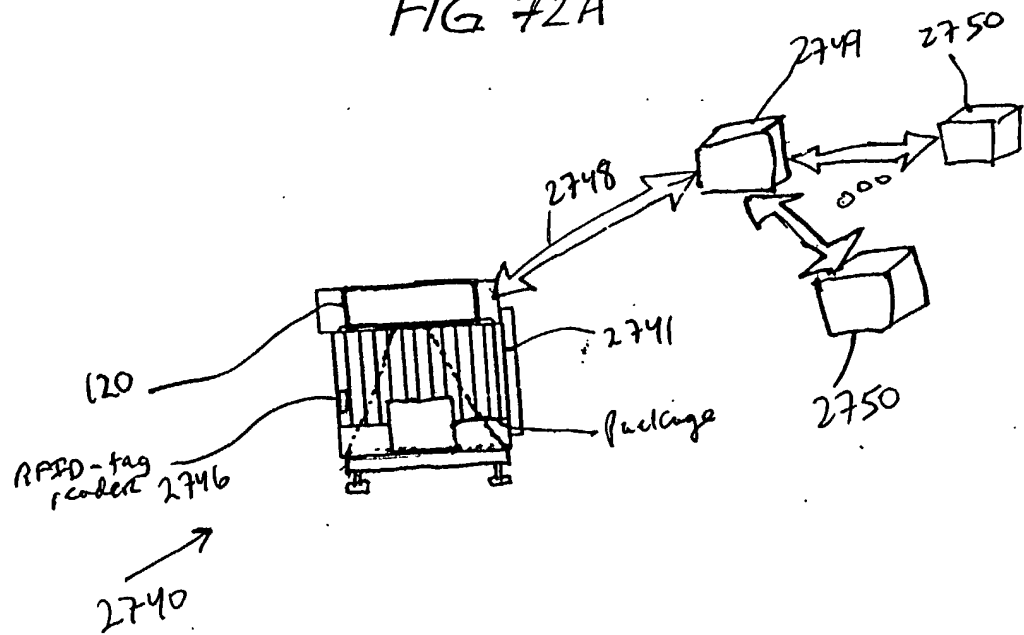


FIG. 72B

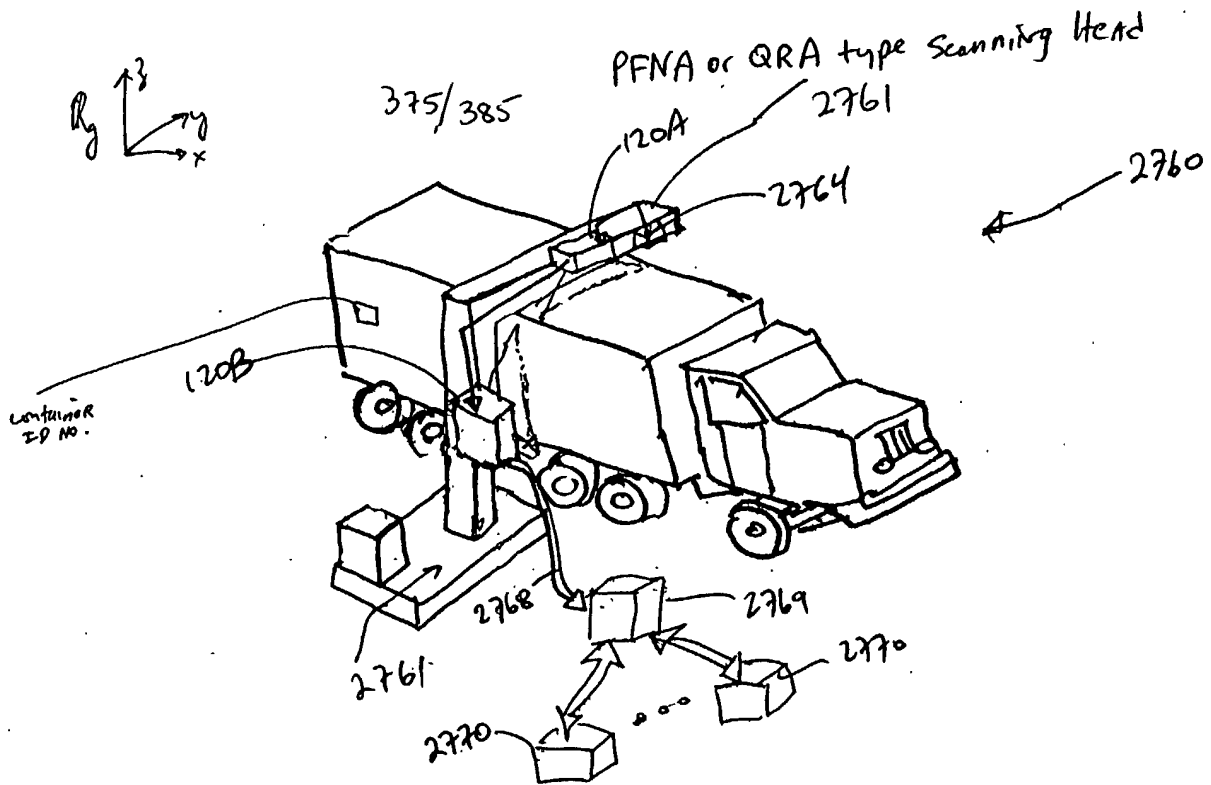


FIG. 73

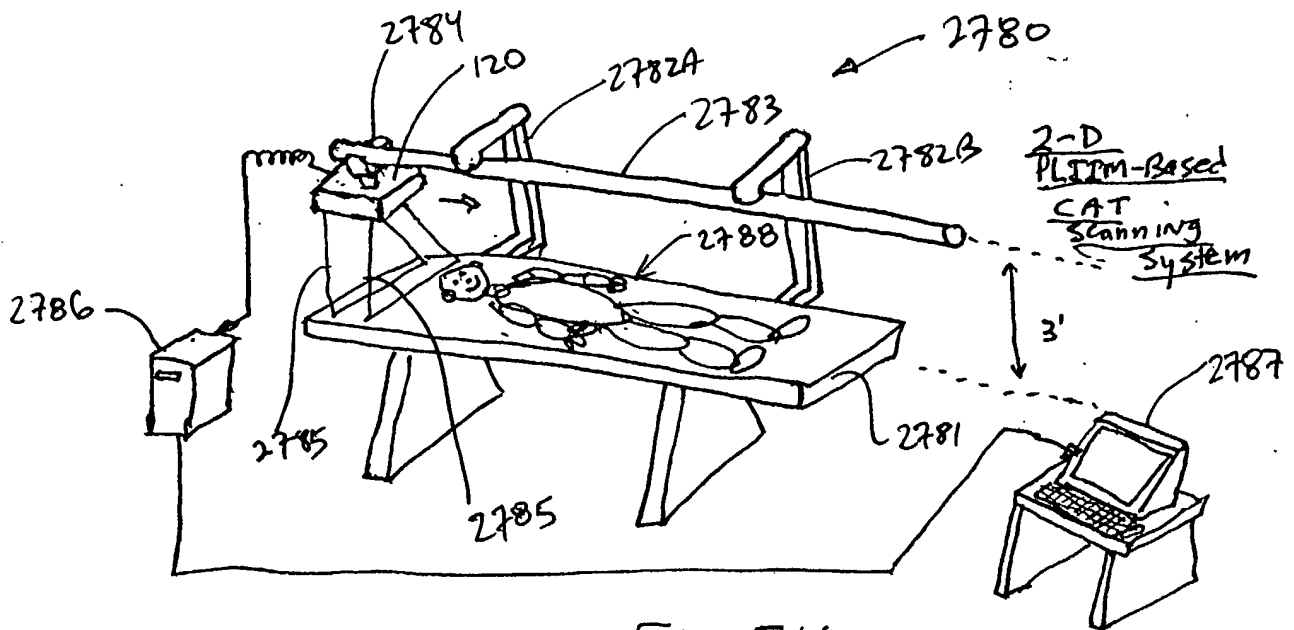
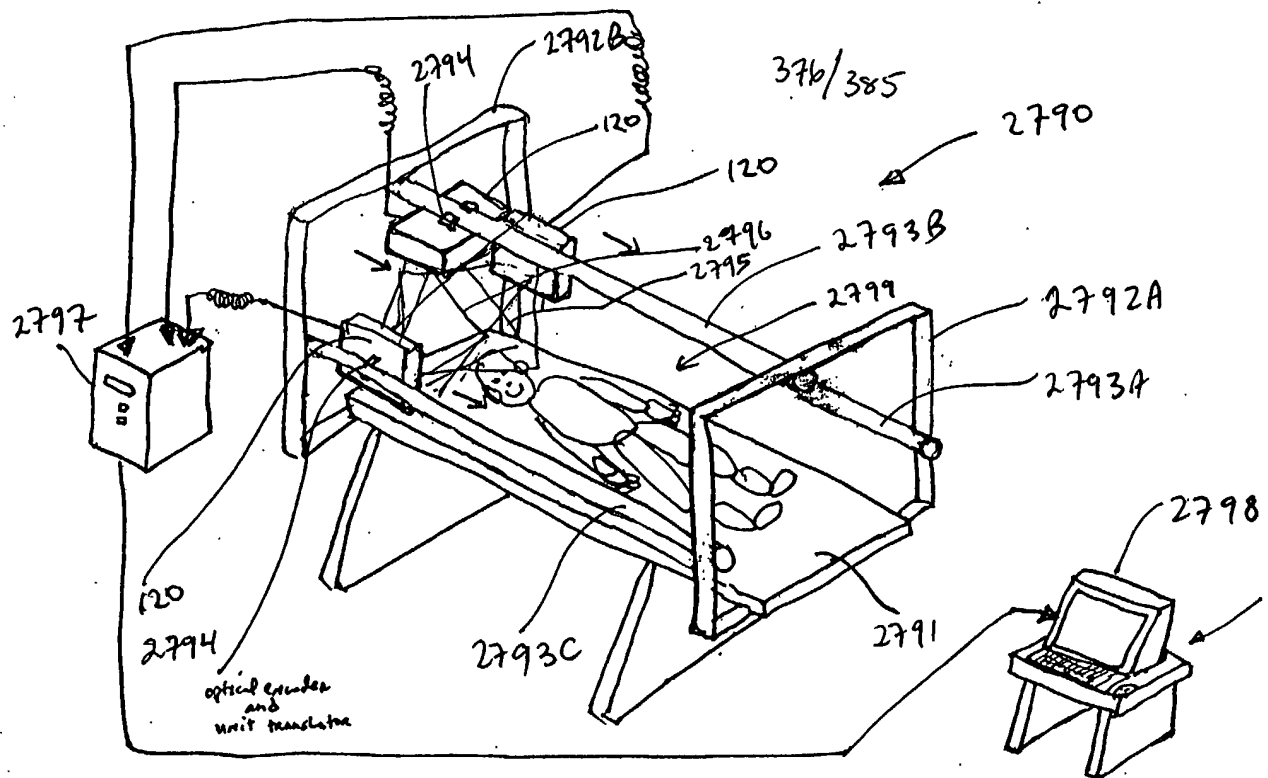
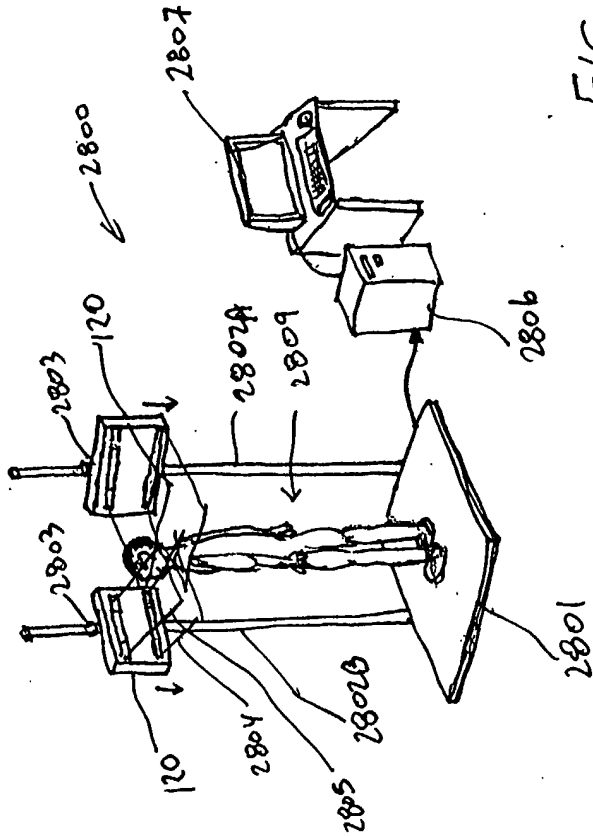


FIG. 74

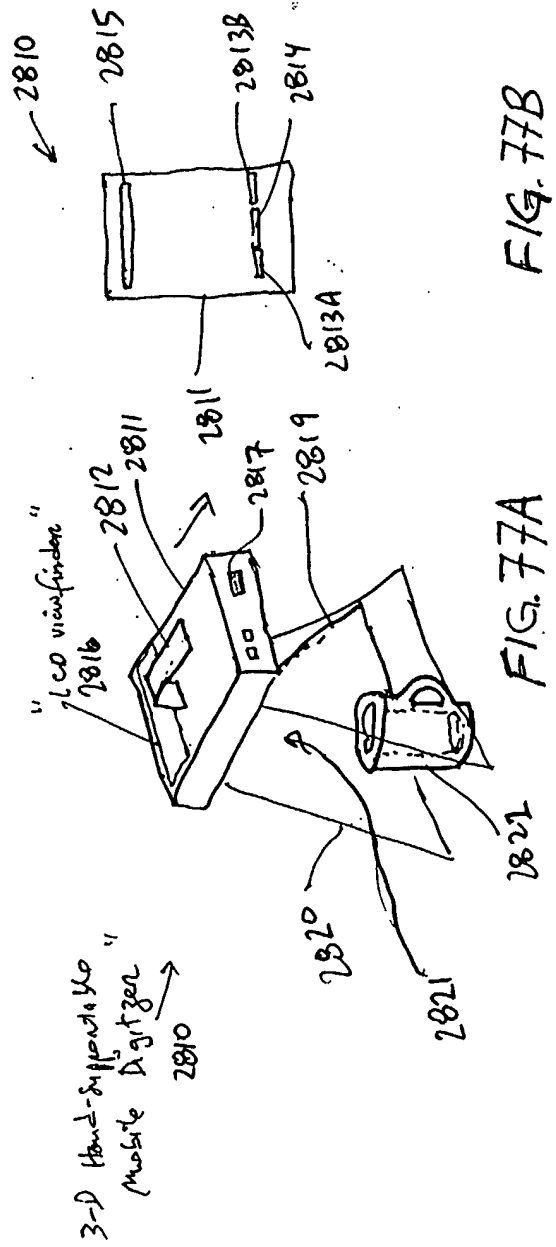


### 3-D PLIM-Based CAT Medical Scanning System

FIG. 75



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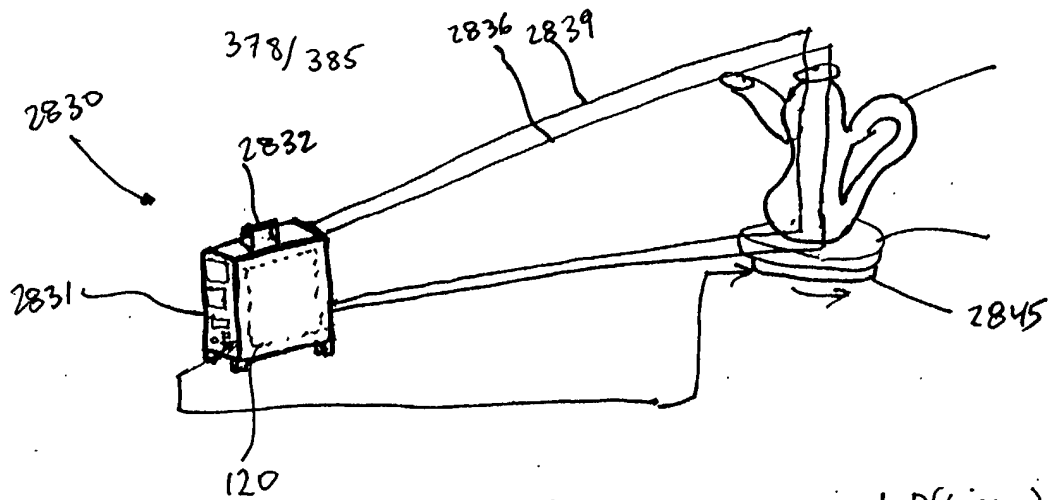


FIG. 78A

1-D(Linear) sensor

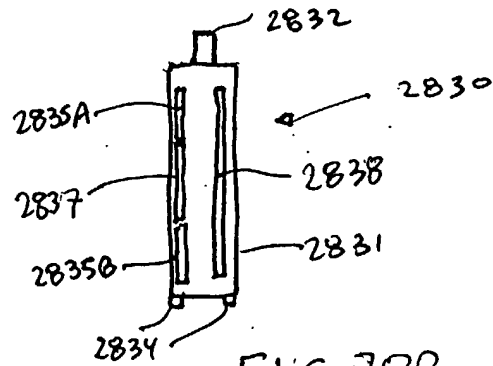


FIG. 78B

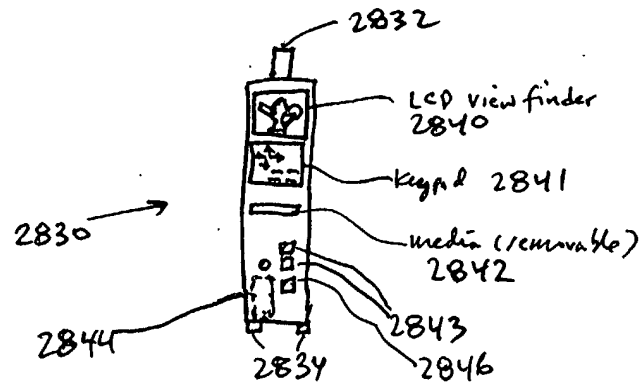
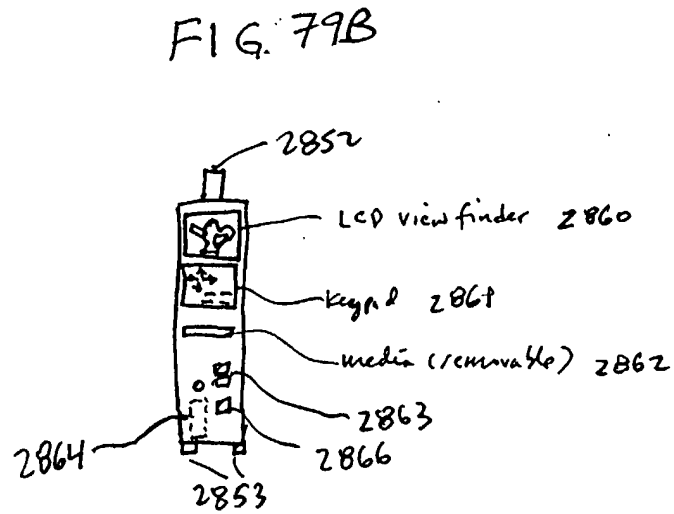
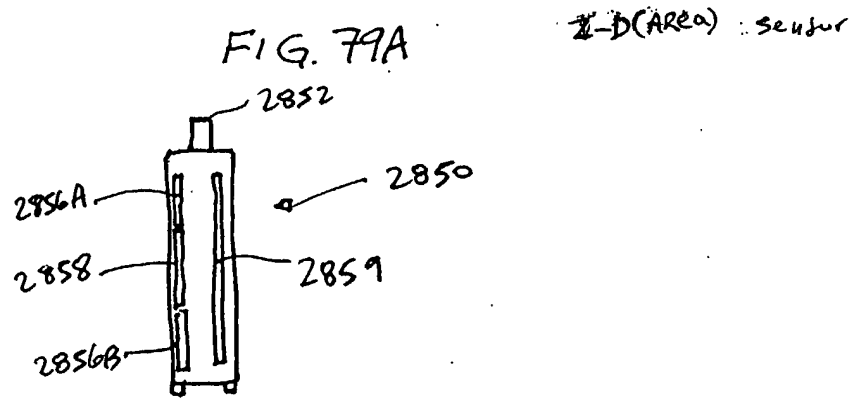
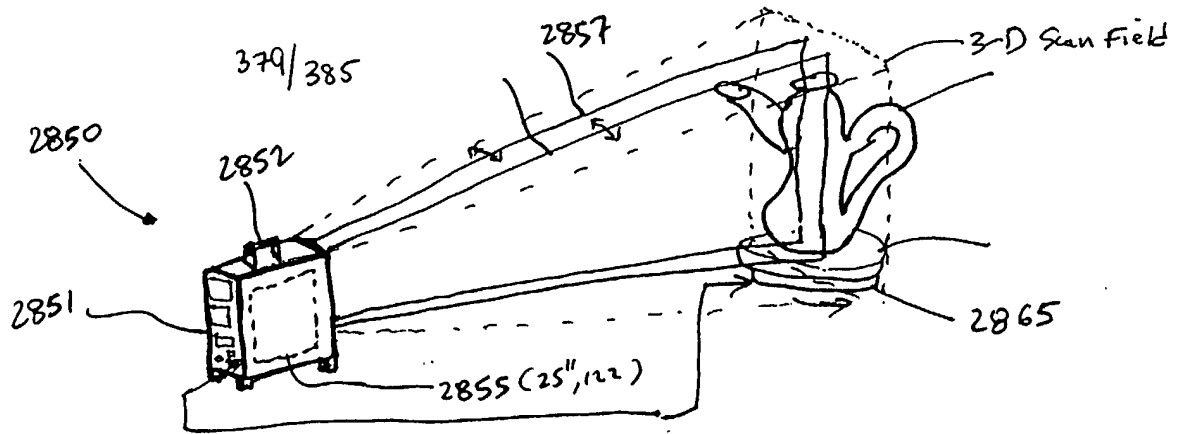


FIG. 78C





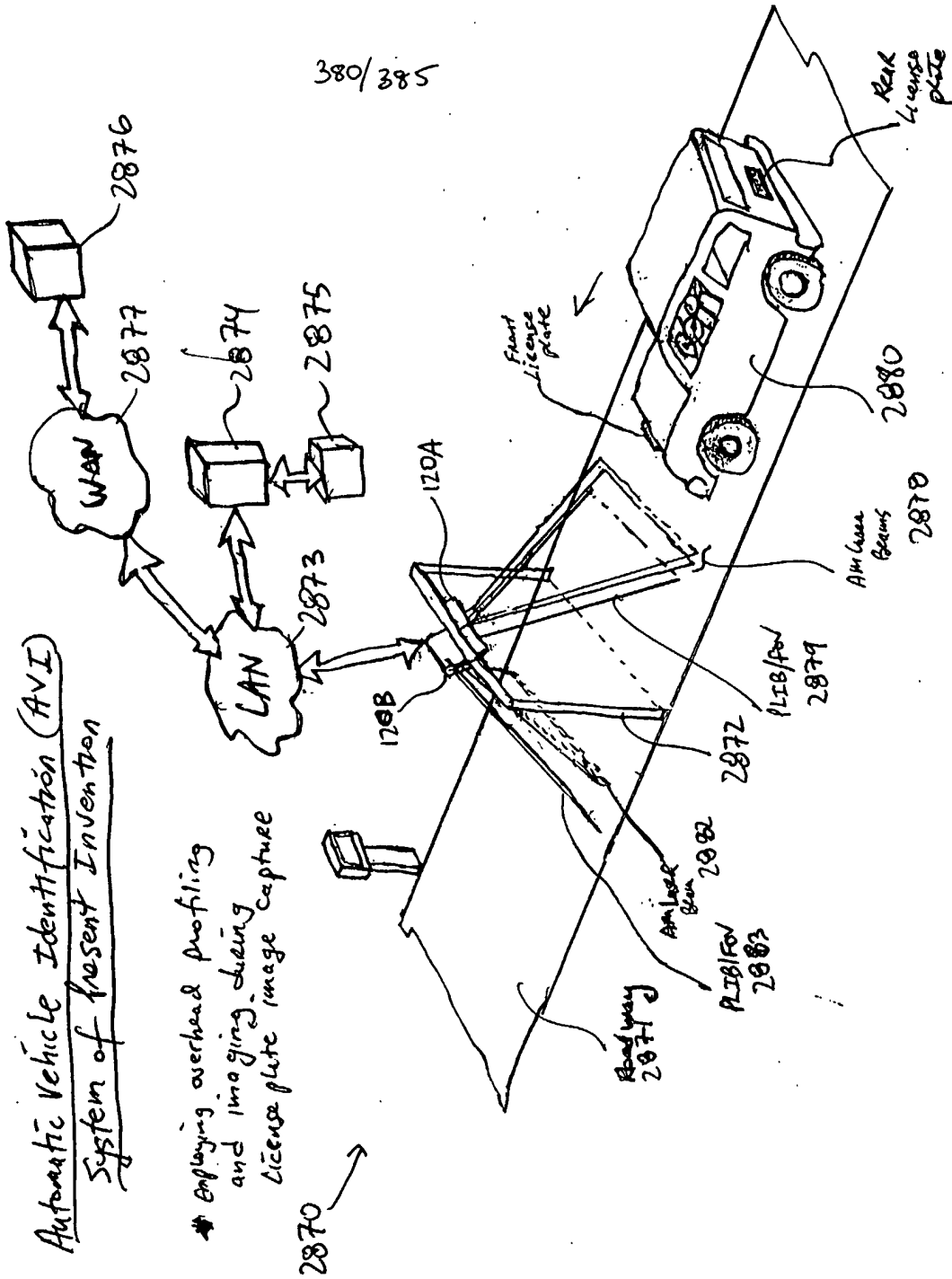


FIG. 80.

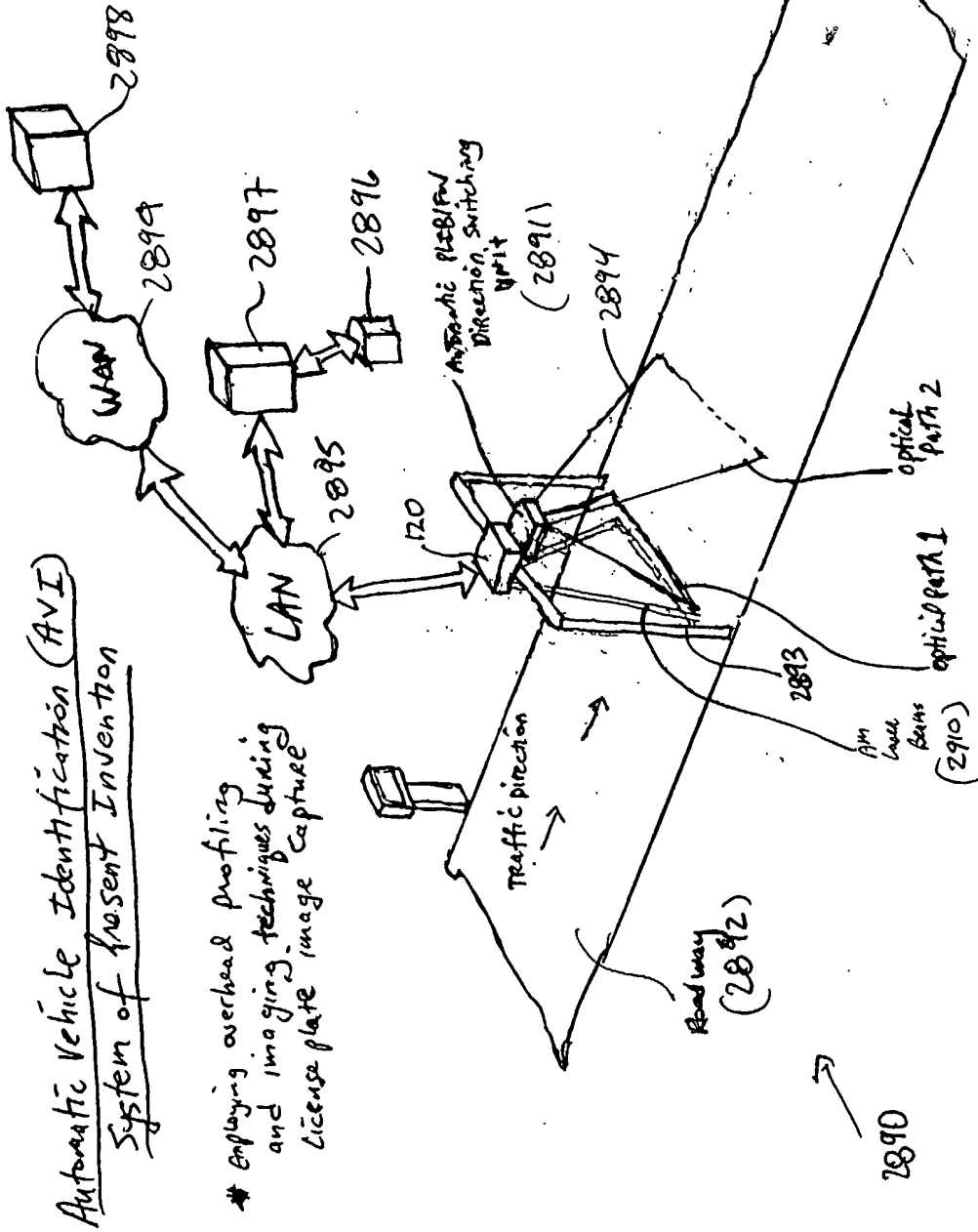


FIG. 81A

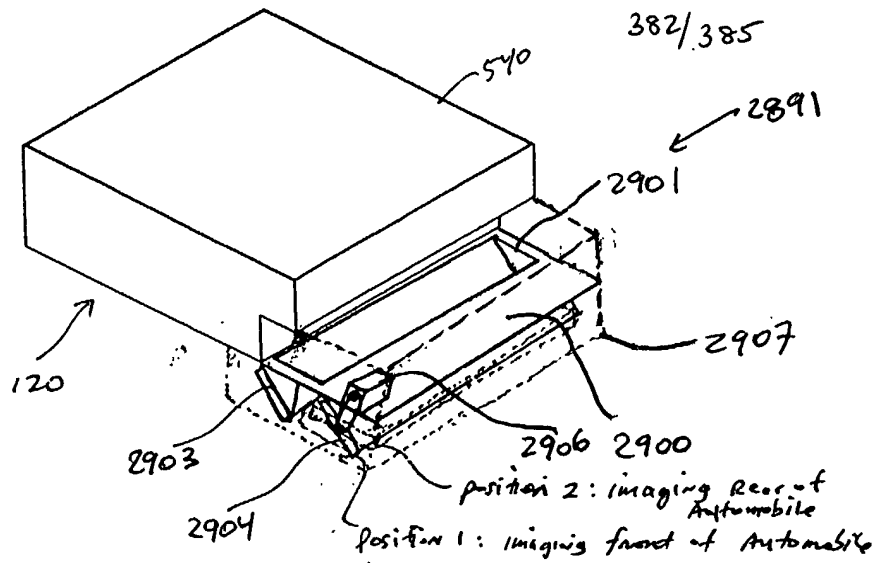


FIG. 81B

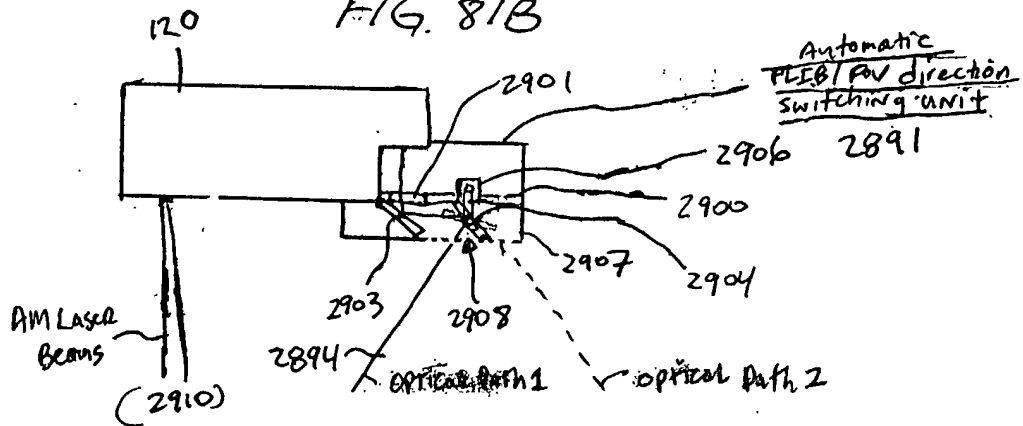


FIG. 81C

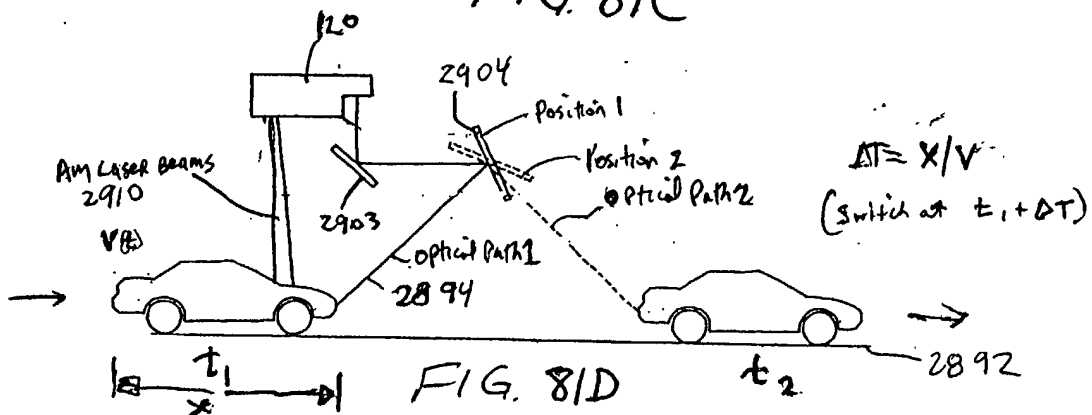
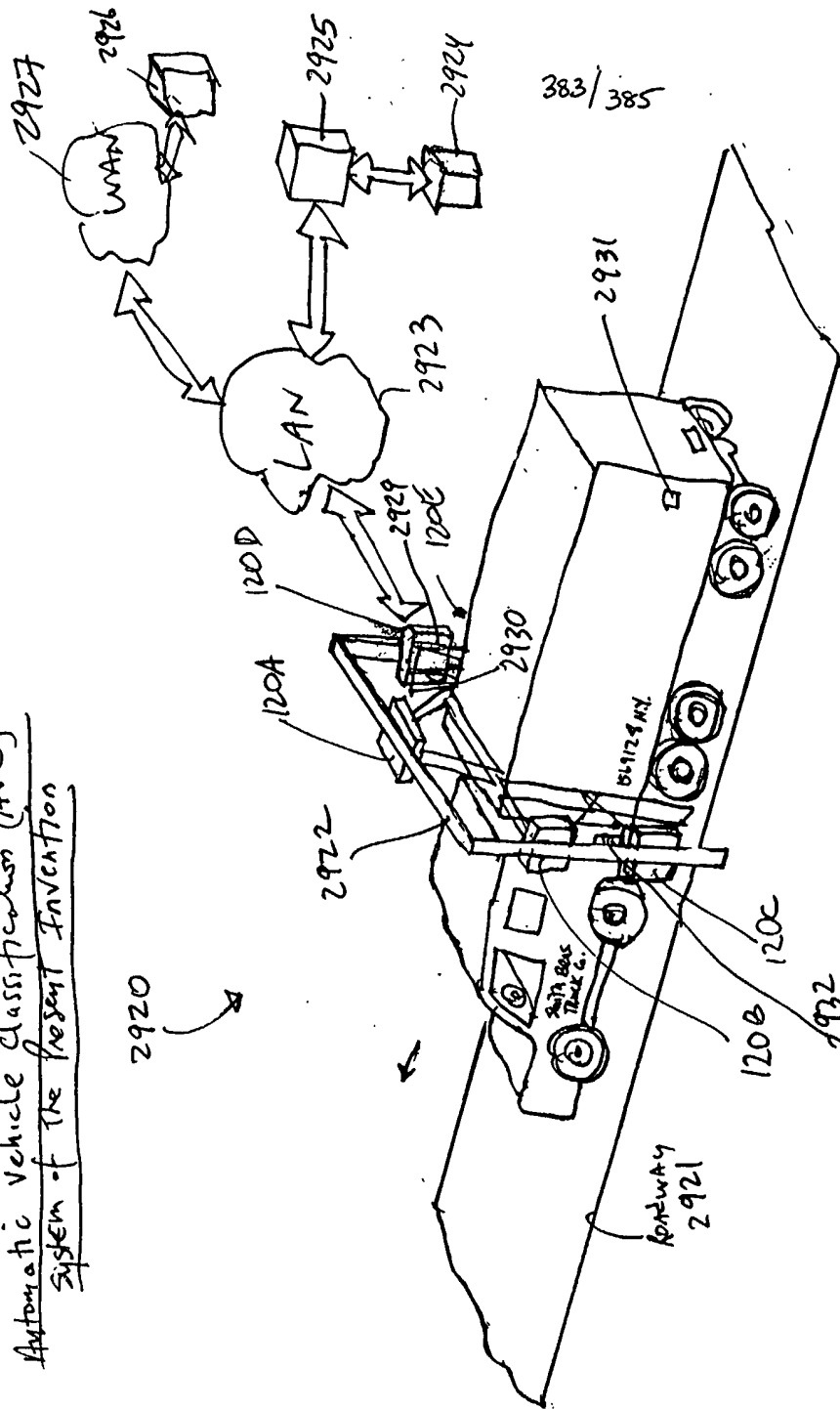


FIG. 81D

## Automatic vehicle classification (AVC)



Employing overhead and lateral  
profiling and imaging  
engineering techniques

FIG. 82.

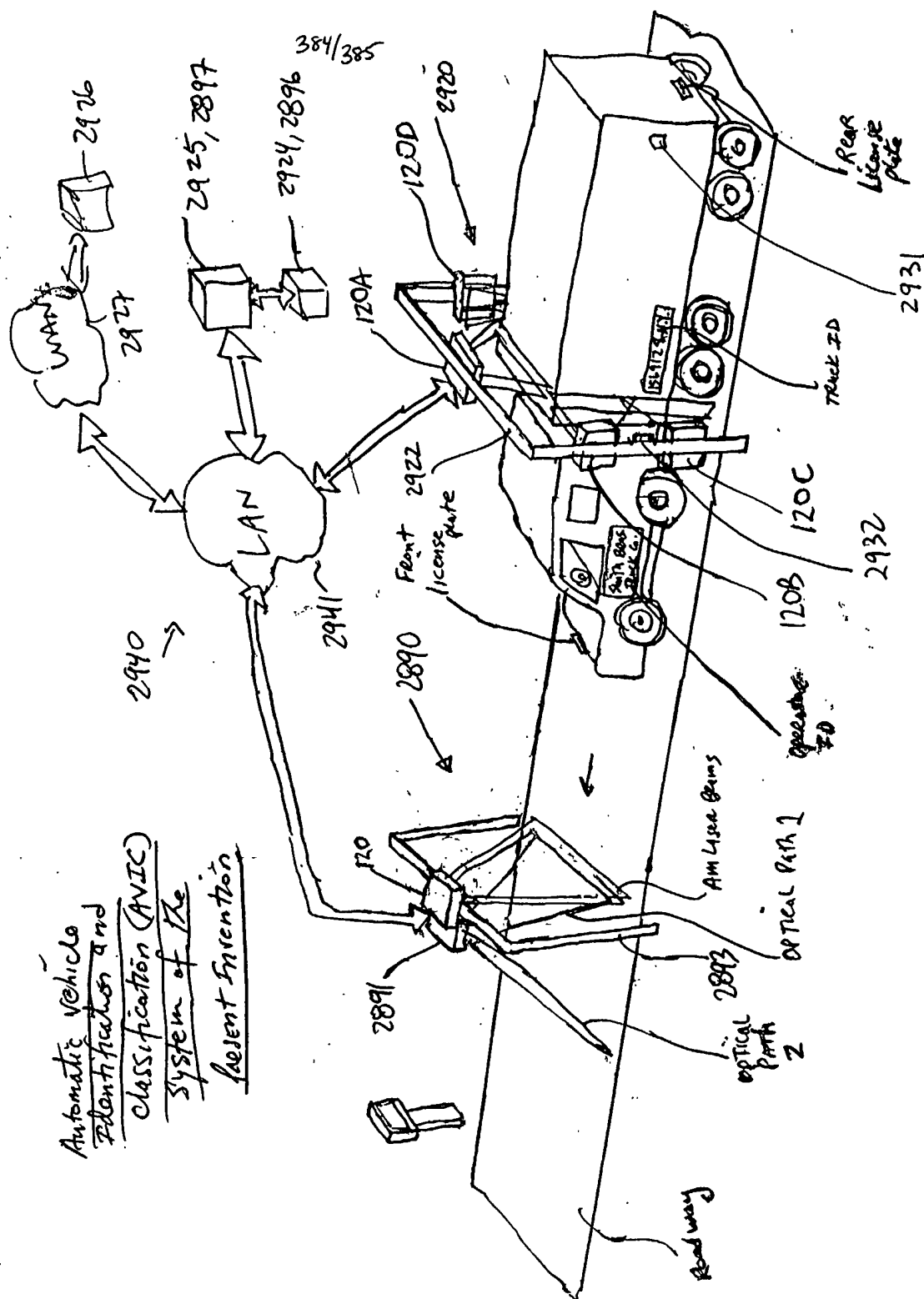


FIG. 83

